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Hints on Cheese-Making.

HINTS

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ON

CHEESE-MAKING,

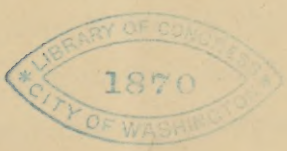
FOR THE

DAIRYMAN, THE FACTORYMAN,

AND THE

MANUFACTURER.

BY T. D. CURTIS.



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INTRODUCTORY.

The following pages comprise the series of articles which appeared, during the last season, in the columns of the Utica Morning and Weekly Herald. It is not claimed that they exhaust the several questions discussed; but it is believed that they constitute the most practical treatise on cheese-making that has yet appeared, and that they embrace the leading features and indicate the more advanced methods of the art as practiced by the best manufacturers. Every experienced cheese-maker may find something in them to object to and criticise, as there is diversity of opinion on many, as yet, not definitely settled questions. The writer would not check honest and intelligent criticism, if he could, but, on the contrary, encourage it. Nor would he have others adopt any of the suggestions, methods or practices herein mentioned, if they think they have better of their own. He would rather stimulate independent thought and action, and urge each to observe closely, experiment thoroughly, and be guided by his own experience. Beginners, without a complete knowledge of all the branches of cheese-making, it is believed, will be able to glean from these

pages what will afford valuable assistance to them; but they should accept nothing as conclusive. There is much to be discovered and learned about cheese-making. Those who have worked at the business for years, without material progress, are not as likely to make important discoveries or improvements as those who now or may hereafter come to a knowledge of the subject with fresh minds and faculties newly stimulated. They will begin where the old cheese-makers leave off, and ought to be able to make advances in the work thus far developed by their predecessors. That each may keep his wits about him and add something valuable to our present stock of knowledge in regard to cheese-making, is the earnest wish of

THE AUTHOR.

Utica, January, 1870.

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HINTS ON CHEESE-MAKING.

CHAPTER I.

BUILDING CHEESE-FACTORIES.

We frequently receive inquiries from parties who contemplate building cheese-factories, regarding certain details which none but those who have actual experience can readily carry out. For the benefit of all needing such information, we have taken pains to prepare the following:

Small or medium-sized factories now seem to be in order. People do not like to carry milk long distances, and this fact undoubtedly accounts for the tendency to small factories, conveniently located. We will give the size of a building suitable for a dairy of 300 to 500 cows. Let it be 80 by 26 feet, with 16 feet posts and two floors. From one end of the lower story take 24 feet for a make room, leaving the remainder for a curing room. Should more than one vat be used, the make room will need to be about six feet larger one way. It may be made so by taking the space off from the curing room, or by putting a projection on the side. The upper story will be used for curing, but should be partitioned off the same as the lower story. The room over the make room should be lathed and plastered, and provided with heating apparatus, so as to make a suitable place for curing early and late made cheese. The building may be cheap, or as expensive as desired.

Either setters and ranges, or the old style tables, may be used. The latter, since small-sized cheeses have come in fashion, are the more common. They are quite as cheap and convenient, and by using them, factorymen avoid the annoyance consequent upon the pretended patent right which is claimed on the rails and turners.

We shall not recommend any particular style of vat, since by doing so we should seem to condemn others. But we will mention the fact that for small factories, vats with self-heaters are preferable and the more economical. A self-heater can be set up and run anywhere, with a piece of stove-pipe to conduct off the smoke, and the expense of boilers, mason-work, etc., is avoided. Five or six cords of maple stove-wood, split fine and well seasoned, will run a good self-heater through the season.

The appearance of a dairy depends very much on the trueness, as well as uniformity in hight, of the cheeses. Good presses and hoops are therefore essential, and save a great deal of trouble as well as give a great deal of satisfaction. The press, therefore, needs to be made heavy and strong, so as not to spring or warp. Let the sill be 14 by 4 inches; the beam, 10 by 6 inches; posts, 4 by 14 inches, slanted from the sill upward to 10, the width of the beam. The sill and beam should be boxed into the posts three-fourths of an inch, and the posts should extend above the beam some 4 inches or more. The top of the sill should stand about 2 feet from the floor. The space between the sill and beam should be 2 feet 4 inches. The lateral space allowed for each hoop should be 2 feet; and in each space between the hoops the sill and beam should be held in place by seven-eighths inch rods of iron. In the

first space from either end, a single rod is sufficient; the next should have two rods, and so on, alternately. The single rod should extend through the middle of the sill and beam, and have heavy washers attached to each end, to prevent the head or nut from settling into the wood. The double rods should go through the edges of the beam and sill, and through heavy washers of iron on the bottom of the sill, and through strong straps extending across the top of the beam. The presses should be made for pressing four or six cheeses, and be made of hard, seasoned timber. The screws should be $1\frac{3}{4}$ inch. Of the various kinds of screws introduced, we know of none better than the old-fashioned ones, with holes through them to receive the bar.

The curd-sink is an important thing in a factory. Its construction is always a matter of considerable speculation and perplexity. We will give dimensions for one suitable for a factory of the size we have indicated. It should be 16 feet long, 2 feet 10 inches in width inside, and 1 foot deep. The bottom should be $1\frac{1}{2}$ inch thick, and the sides 1 inch thick. The legs should be 3 feet high, extending up the sides, so that the top of the sink will be 3 feet from the floor. The sink should be made of clear, seasoned pine, and the legs be well braced, with cross and side pieces connecting them about 6 inches from the floor. Racks and a cloth strainer may be used, or a false bottom with perforated tin strainers may be substituted.

The proper hight of the weighing can, of the dumping window from the ground, and the best apparatus for unloading, are generally matters quite perplexing. The proper hight of the receiving can is that which gives a gentle slope to the conductor, as too much current not only causes the milk to slop over the sides of the

strainer, but drives the dirt through the strainer. With vats 3 feet 2 inches high, the platform for the scales should be 3 feet 8 inches from the floor.

Of the many appliances used for unloading, none is simpler, cheaper or more satisfactory than the crane. Make it of scantling 4 by 4 inches, the upright 8 feet long, and the arm 7 feet. Hang it as you would a barn-door. Fasten one end of a strong half or three-quarter inch rope to the end of the arm; run it through a pully to which is attached the tongs; then over a 4 inch pully above, near the end of the arm; run it back over a similar pully next to the upright, then down to a 3 inch roller, with a crank, at a convenient hight for turning. One end of the crank must be sustained by a strong iron strap, bowing outward, in the direction of the arm, to admit the roller (about 6 inches long) lengthwise, and fastened to the upright above and below.

The window-sill should be not more than two or three inches above the edge of the receiving-can, which should stand close to the window, just clearing the sill. The road should be eighteen inches below the platform on which stand the scales and weighing can. Then the can, when raised just enough to clear the wagon-box and wheels, will be of the right hight for dumping when swung round to the window. Many make the mistake of getting the road too low, which causes the unnecessary work of raising the milk 3 or 4 feet by hand before it can be dumped, and wastes strength and time, both in raising the can and lowering it back again into the wagon after it is emptied.

In building a factory, every provision should be made for cleanliness. It should be located near a living spring of water, ranging in temperature somewhere

between 45° and 55°. There should be sufficient water to fill, at all times, an inch pipe, and care should be taken to secure a fair head—enough to carry the water above the vats, at least. The water should be carried in pipes under the building, along by the ends of the vats where it is wanted, with penstocks rising from the pipe, to furnish water for each vat. The faucets in the penstocks should be all of the same hight—if any difference is made, the one farthest from the head might be a quarter or half an inch the lowest. Outside should be a penstock, to carry off the superfluous water. The outlet to this should be a few inches higher than the faucets in the penstocks for supplying the vats with water. This is necessary to secure a flow of water in the factory. In freezing weather, and during the winter, the penstocks in the factory can be removed, until needed for use, and the holes in the pipe beneath plugged up. An extra faucet in one of the penstocks at the ends of the vats, inserted high enough from the floor to set a pail under, will supply all the necessary water for cleaning and other purposes.

CHAPTER II.

PRODUCTION OF MILK.

The requisites of good milk have been so frequently and fully discussed, that we need not more than briefly advert to them now. The importance of good milk, for either cheese or butter, will be conceded, and therefore the question need not be argued.

The first requisites of good milk are good cows. But these will disappoint their owners if they have not good keep. Plenty of good clean hay and pure water, with warm quarters, are indispensable. The old-fashioned method of allowing cows, or other cattle, to weather all kinds of storms, with a snow-bank for a bed at night, we believe is pretty effectually done away with. It has been found that it does not pay. It is not yet quite so universally admitted that generous feeding is equally advantageous, nor that a warm stable is as much an advance on an open, cold one, where the cows stand and shiver throughout the twenty-four hours, as a common shelter is an improvement on no shelter. Yet, a warm stable, which may be had for a small expense, is decided economy, in the saving of food, as well as a comfort to the cows; and generous feeding will be found a profitable investment, both by the increased flow of milk and by its increased richness. A poorly-kept cow will give less milk than a well-kept one, and its poorer quality will be more manifest than the diminution in quantity. When turned out to grass, if the feed should prove good, it will take the cow weeks to build up her system and get in the condition she should have been in at the start; and though the

quantity and quality of her milk will improve, she will reach the time when the mess naturally begins to shrink before she will have thoroughly recuperated. After this, the richness of the milk will probably be satisfactory. But in case the season should open dry and cold, so that the grass starts slowly, and is then followed by the hot dry weather of July and August, as is not unfrequently the case, a cow that starts "spring poor" will scarcely get in good condition before the grass is nipped by the fall frosts and it becomes necessary to begin to fodder.

There is a marked difference in the quality of the messes of milk delivered at a cheese-factory. The use of the lactometer and cream-gauges will show this. It will be an interesting experiment, for cheese-makers who never tried it, to test in this way the quality of the milk delivered by the different patrons, and then ascertain the style in which each keeps his cows, the character of the pastures of each, the kind of water which the pastures afford—whether brook, river, swamp or spring—and to note any other facts and conditions which may be apparent or may suggest themselves. It will be found, we think, that bad wintering and poor pastures have as much or more to do than anything else with the production of poor milk. No breed of cows nor selection of a dairy can wholly counteract these evils. The yield of milk will undoubtedly be greater and better with some cows than with others; and so with naturally good cows, good wintering and pasturing will show quite as marked improvements.

We have in our mind an instance where, at the opening of a cheese-factory, only a few of the farmers, having the largest dairies, delivered milk. They were all men who fed their cows well during the winter, and

gave them meal before and after coming in. The result was an astonishingly large yield of cheese from milk at that season of the year. But as the messes increased, and milk from dairies poorly-kept came in, the yield of cheese in proportion to the number of pounds of milk steadily diminished. The lactometer and cream-gauges showed that the poorest milk came from the poorest-kept cows.

The forepart of the season proved a cold and wet one, which made the grass more juicy and less nutritious. This, with the accidental or intentional watering which the milk got from the rain falling in the cans, either at home or on the road, was also believed to decrease the yield of cheese. It appeared that milk coming long distances through the rain, other things being equal, showed more water than that brought short distances. Manifestly, some sort of shelter to the cans should be devised, to be used both at home and on the road, during rainy weather—and the same for keeping off the rays of the sun, in fair weather, is equally desirable.

All through the season, in the instance referred to, there was a marked difference in the quality of the milk of the well-kept and of the poorly-kept dairies. Swampy pastures also seemed to impoverish the milk. Those pastures that were dry, with pure water accessible, appeared to produce the richest milk. While the milk of the best dairies, on being tested, would indicate a yield of a pound of cheese to eight or nine pounds of milk, the milk of others would not yield a pound of cheese to less than eleven or twelve pounds of milk. The average number of pounds of milk for a pound of cheese, during the season, was about 9.9.

In the foregoing, will be seen a manifest objection to the factory system, as at present conducted. The quality of the milk delivered is nowhere taken into consideration. The man who has a well-selected dairy, keeps it well, and delivers milk that will turn out, for the season, a hundred pounds of cheese for every nine hundred pounds of milk, gets no more returns for a given number of pounds of milk than the man who delivers milk so poor that twelve hundred pounds of it will not make more than a hundred pounds of cheese, or the same as the former's nine hundred pounds. There is a difference of about twenty-five per cent. in the quality of the milk turned out by the good and the poor dairies, one-half of which the owner of the former loses, and the other half of which the owner of the latter gains, by getting his milk made up at the factory. Some means should be devised for remedying this piece of injustice, if the better class of dairies is to be retained by the factories.

CHAPTER III.

COMPOSITION OF MILK.

The composition of milk, though frequently discussed, is not generally well understood. It is quite variable, not only in the milk from different cows, but in that from the same cow at different times, and in different conditions, but especially at different seasons of the year. It is more buttery in winter, and more cheesy in summer. A cow milked three times a day would give more in quantity but poorer in quality, than if milked twice; while one milked twice a day will yield more milk than if milked once a day, but one milking a day would be the richer. The first milk drawn from the udder is more watery than what follows; the last is the richest. The accumulation of milk in the cow's bag is influenced by the law of gravitation. The water being the heaviest ingredient, settles to the bottom, and is the first milked; the cream, which is the lightest, rises, and is the last milked. That is to say, a partial separation takes place in the udder, sufficient to make the "strippings" some ten or twelve times as rich in butter as the first milk drawn. We would, therefore, infer that the first third contains the most water, the second third the most cheese, and the last third the most butter. There is said to be a difference in the milk drawn from the compartments of the udder of the same cow, or from different teats.

The variation in the composition of milk, of course, is indicated by different chemical analyses, no two of which can be found to exactly agree. We give an analysis by HAIDLEN. He found that the specimen con-

tained, in 1,000 parts, 873 parts of water, 30 of butter, 48.2 of cheese, 43.9 of sugar of milk, 2.31 of phosphate of lime, .42 of magnesia, .47 of iron, 1.04 of chloride of potassium, and .66 of sodium and soda. Other chemists have found albumen among the constituents of milk, and this ingredient is believed, by many, to be the one that first commences decaying, in hot weather, and produces, "tainted" milk, "floating" curds, and "huffy" cheese. Skimmed milk has been found, in some instances, to contain as high as 97 parts of water in 100, and only 3 per cent. of solids, or cheesy matter. "Swill milk" has been found to contain as low as 1½ per cent. of butter. An analysis of the first milk taken from a cow's bag after calving, showed it to consist of 15.1 per cent. of caseine, or cheese, 2.6 of butter, 2 of mucous matter, and 80.3 of water. Ordinary pure milk will average about 12½ per cent. of cream. But it is not unfrequently found to yield 15 to 20 per cent., and even as high as 25 per cent. of cream has been obtained. If milk yields less than 10 per cent. of cream, it is below the average, and unprofitable for butter-making.

We know of no single instrument that will at once indicate the quality of milk. What is called the lactometer, but is properly a hydrometer, will indicate the density of milk, and if its specific gravity in a pure state be known, it will show the amount of water added, if any. On an average, milk is about 4 per cent. heavier than water. That is, a hydrometer with a scale graded at 100 for milk at 60 ° Farenheit, ought to sink to 96 in water. The variation in the density of milk will be shown by an experiment given by CHARLES L. FLINT, in his "Milch Cows and Dairy Farming." He says:

"For the purpose of showing the difference in the specific gravity of different specimens of pure milk, taken from the cows in the morning, and allowed to cool down to about 60°, I used an instrument graduated with the pure milk mark at 100, with the following results: The first pint drawn from a native cow stood at 101. The last pint of the same milking, being the strippings of the same cow, stood at 86. The mixture of the two pints stood at about 93½. The milk of a pure bred Jersey stood at 95, that of an Ayrshire at 100, that of a Hereford at 106, that of a Devon at 111, while a thin cream stood at 66. All these specimens of milk were pure, and milked at the same time in the morning, carefully labeled in separate vessels, and set upon the same shelf to cool off; and yet the variations of specific gravity amounted to 25, or, taking the average quality of the native cow's milk at 93½, the variations amounted to 17½."

It will be seen, by these experiments, that the richer the milk in butter, the less the specific gravity, thin cream being 30° below the water mark. The richer the milk in caseine, or cheese, the greater the specific gravity, the milk of the Devon indicating 15° above the water mark. Watering milk will of course reduce the specific gravity of milk rich in cheese, and by this means it can be made to indicate the average density of pure milk. In the same way, milk rich in butter may have its specific gravity increased until it nearly reaches that of water, but no amount of watering can make it indicate over 96°, which is the figure given for pure water. A little salt, or other ingredient, may be added to bring the density up to the pure milk mark. So the blueness of milk, produced by either skimming or watering, may be removed by the use of burnt sugar,

which will give it a rich color. Or annotto may be used for the same purpose. Many expedients have been resorted to, from time to time, by the dishonest, for the purpose of disguising the impoverishment of milk by skimming and watering.

"But," says some one, "why tell dishonest men how they can skim and adulterate their milk?" We have not done so. We have told honest men some of the practices of the dishonest, with the view of enabling them to detect the fraud. True, the hydrometer is not an accurate or legal test; but it shows the exact density of the milk tried, and this is a very important point. When you have decided this, by the use of the cream-gauges, you can determine the amount of cream; and if you let the milk stand until it coagulates, and the cheese separates from the whey, you can tell the relative proportion of water and cheese. This may be a somewhat slow and clumsy process, but it is nevertheless decisive, and often repays the trouble. Foreign substances, so far as not held in solution by the water, or not entangled in the cheese or cream, will settle at the bottom of the glasses. Besides, with these evidences to start on, the ways of a suspected person can be watched, and he often be caught in the very act of violating the law, which we quote below:

§ 1. Whoever shall knowingly sell, supply, or bring to be manufactured to any cheese manufactory in this State, any milk diluted with water, or in any way adulterated, or milk from which any cream has been taken, or milk commonly known as skimmed milk; or whoever shall keep back any part of the milk known as "strippings;" or whoever shall knowingly bring or supply milk to any cheese manufactory that is tainted or partly sour from want of proper care in keeping pails, strainers, or any vessel in which said milk is kept,

clean and sweet, after being notified of such taint or carelessness; or any cheese manufacturer who shall knowingly use, or direct any of his employes to use, for his or their individual benefit, any cream from the milk brought to said cheese manufacturer, without the consent of all the owners thereof, shall, for each and every offense, forfeit and pay a sum not less than twenty-five dollars, nor more than one hundred dollars, with costs of suit, to be sued for in any court of competent jurisdiction, for the benefit of the person or persons, firm or association or corporation, or their assigns, upon whom such fraud be committed.

CHAPTER IV.

TAINTS AND ODORS.

Whatever be the grade of cows and the quality of milk, much depends upon its management. A good deal of care and attention are requisite for the attainment of the best possible results with such milk as we may have to work up. But before we come to the process of milking, let us look a moment at the effect of food in regard to taints and the flavor of milk.

It is now universally conceded, that the flavor as well as the quality of the milk depends very materially upon the food of the cow. Coarse swamp-grasses and weeds do not produce as rich or sweet milk as clover, timothy and red-top, grown on dry upland soil; while swamp-water gives a ranker flavor than the sweet spring and brook-water of hilly regions. Leeks are not the only weeds which taint the milk before it is taken from the cow. All rank vegetable growths lend a similar influence to injure flavor. Indeed, that which the cow eats is what she makes the milk of, and if these offensive things are taken into her system, she cannot be expected to turn out milk that will not partake of their qualities, any more than a man can be expected to make sweet cider of sour apples by running them through the mill and press. Even the atmosphere which the cows breathe affects the flavor of the milk. Carrion in the lot where the cows feed has been known to impart its odor to the milk of the dairy. Dirty stables and barnyards, the odor of which is breathed by the cows, makes the milk "taste of the barnyard," as the common expression goes.

It becomes of the greatest importance, therefore, that cows should have clean, sweet pastures to feed in, and clear spring or brook-water to drink; also, that they should have clean, well-ventilated stables to stand in, and be milked in clean yards or stables, as free from all taints and bad odors as possible. The cows should not be heated by hurried driving with a dog, or by a man or boy on horseback, as this fevers the milk, giving it an unwholesome quality, leading to rapid decay as well as producing bad flavor.

And, if quantity as well as quality is to be attained, pastures must contain plenty of feed, so that the cow can soon fill her stomach and then lie down or stand in the shade and ruminate at ease, instead of working constantly from morning to night to gather food enough to satisfy her. She must have water handy, instead of away back in some retired corner of a large pasture, as she naturally wants to drink a few swallows quite often, in warm weather, but will go until she gets excessively dry and feverish before she will travel a long distance to get water. When thus very dry, she drinks an inordinate quantity, which makes her feel heavy and uncomfortable—and whatever annoys a cow lessens the flow and reduces the quality of the milk.

A little reflection must make these things apparent to every reasoning mind. Cows must have plenty of clean, wholesome food and pure water, and must be every way made comfortable and contented, if the largest flow and best quality of milk is expected. The cow is sure to show, not only her own naturally good or bad qualities, but her keep and care, in the milk pail. There is no cheating her. She will make a corresponding discount or dividend on every iota of ill or good treatment she receives. In this, she is an exact

accountant, and she will insist upon keeping the account square.

Milk requires not only favorable conditions for its production, as above indicated, but needs great care and cleanliness after it is drawn from the cows. A foul yard or stable will impart its odors to the milk. Uncleanliness in milking not only gets filth into the milk, but taints and injures its flavor. Some, for this reason, recommend washing the cow's bag before milking. But if this washing is done with cold water by the milker, it is quite likely to consume time, cool the bag and cause the cow to hold up a portion of the mess. Experience shows that the quicker the milk can be drawn, after the operation is commenced, the better the yield. If washing is done, it should be with warm or tepid water, and be the work of one person, who should go through the whole dairy in advance of the milkers. But, in our opinion, where the stable or yard is kept clean, a careful brushing of the bag with the hands before beginning, and care in holding the pail a little toward you from under the teats, will obviate all the evils of uncleanliness from milking; and, certain it is, where all the surroundings are dirty, no amount of washing the cow's bag will get rid of the bad effects of the odors arising from the filth. Clean quarters for milking are indispensable to the furnishing of sweet, nice-flavored milk.

Cleanliness in all the pails, cans, strainers, and whatever comes in contact with the milk, is equally necessary. Thorough washing, not omitting the use of soap, scalding and airing, are the only things that will keep them sweet and free from taint. All implements and utensils should be as free from sharp corners as possible, as these are difficult to clean, and taints are apt to be left

in them to come in contact with the new milk and infect it, as a small quantity of yeast leavens a batch of bread. The milk will, therefore, soon begin to ferment, producing one of the worst conditions which the cheese-maker has to contend with, and rendering it impossible for him to make firm, clean-flavored cheese of the milk. In no case should wooden vessels be used for milk. The wood will absorb the milk, and no amount of washing and scalding will get it entirely out. What remains will get frowy and impart its infection to the warm milk and cause it to rapidly taint. Tin vessels are the best of anything yet devised, and are recommended universally by the best dairymen and by the American Dairymen's Association. Those with pressed or round bottoms, having no inside angles for ferments to collect in, are preferable. These can be obtained for a trifle if any more money than common tin pails cost, and should receive the preference of dairymen when purchasing.

In short, the greatest care should be taken to have all things strictly clean—not only those that come in contact with the milk, but those surrounding it. The milkers should be as clean, careful and expeditious as possible, avoiding all unnecessary or unusual motions, and everything calculated to alarm or excite the cows. Then, if the cows have had proper food, drink, care and treatment, there is little reason to apprehend anything objectionable in either the quantity or quality of the milk.

CHAPTER V.

COOLING MILK.

The management of milk, when once obtained, is the great practical consideration with the farmer and cheese-maker. But the first handling and care devolve upon the farmer; the cheese-maker's duties begin with the delivery of the milk at the factory. Much, very much, depends upon the treatment of the milk after milking, and the consequent condition in which it is delivered. We will therefore begin at the stable or yard and follow the milk through all its stages, until it is run into the weighing-can.

Previous suggestions as to cleanliness, etc., being adopted, we find the hot milk in the pails ready to be strained into the can standing on the platform or in the wagon. We say "strained," because this is necessary to absolute cleanliness, which affects the flavor, though at some factories the patrons are directed not to strain the milk, for the reason that poor care is so often taken of the strainer, and the keeping of the strainer drawn tight over the top of the can prevents cooling and hastens taint. For this reason, we would recommend the use of strainer-pails, unless the cloth strainer can be stretched above the can so as to allow the heat to escape and the cool air to come in. These precautions should be observed, most certainly, if no means is adopted for cooling the milk before starting for the factory.

The subject of cooling and airing milk has long been earnestly discussed, and the importance of cooling, at least, we believe is universally conceded. But how is this

end to be attained, with the thermometer indicating an average temperature of 80°, and perhaps higher? The first and simplest suggestion is to set the can in a tub of cold water—cold spring or well-water, or iced water—and to give the milk frequent agitation with a dipper or other convenient article, care being taken to stir it from the bottom, as the cold milk naturally settles, and of course the hot milk lies on the top. Gentle agitation secures the advantage, also, of preventing the cream from rising. This makes trouble, and consumes a little time, but we believe the result will well repay both.

The milk-can should, by all means, be kept out of the sun's rays, and in a clean airy place. As to the importance of airing milk, there is a difference of opinion. Some assert that the airing is beneficial only so far as it assists in cooling, and that if we can succeed in cooling the milk down to 60°, or thereabouts, immediately after milking, we shall attain all the good results apparent from exposure to the air. All the "animal odors," they say, disappear. Be that as it may, it is scarcely possible to cool milk without more or less exposure to the atmosphere, and we have never heard it claimed that any bad consequences follow this exposure. It is possible, however, that it may more rapidly absorb oxygen, and thus sooner sour. The probability is, that any process which will secure the proper cooling will also afford the necessary exposure for the escape of all animal or other odors likely to pass off in the form of gas. Therefore, practically, it is of very little importance whether we consider the question of airing milk, in any of the stages of its management. So we will first look after the processes which secure known advantages.

Several inventions for the purpose of cooling milk

have made their appearance within the past year or two. Some for the use of factories, which seem to work quite satisfactorily, and others for the use of farmers, none of which, we believe, have yet been received with much favor. They are mostly too complicated, if not too expensive, and too difficult to keep clean, to ever become generally adopted. Yet, enough has already been developed to convince us that the desideratum, of a satisfactory apparatus for cooling milk as fast as, or soon after, it is taken from the cow, can be realized. The great trouble is, to make farmers use it faithfully, if at all.

The cooling of milk as fast as milked, or very soon afterward, is the great question now presented to farmers and cheese-makers. It is of quite as much and more consequence, than keeping it cool at the factory—for milk is often so far advanced in decomposition, if not actually sour or tainted, when received, that it is impossible to work it up satisfactorily. Some Yankee must give us a simple and cheap apparatus that will effect the desired result. Such an invention will greatly improve the quality and increase the consumption and price of American cheese. But, in the absence of anything better, the can set in a tub of water and the milk frequently stirred, would be a great improvement on starting for the factory with hot milk. If the water can be made to constantly run into the tub, fresh and cool, as the warm water runs out, so much the better. Another improvement would be some kind of wagon-cover, permitting the air to pass under it, to keep off the sun in clear weather and keep out the rain in wet weather. The hot rays of the sun, pouring on a can of milk for the distance of two or three miles, perhaps—especially if the milk is not cooled before starting—cannot fail to do it serious injury. Milk thus exposed

often has a very offensive smell when it reaches the factory-door. This shows that it is already tainted and in a condition to injure the good milk in the vat into which it is run, and cause a porous or "huffy" curd.

The question as to the effect of suddenly cooling milk has been somewhat discussed; also as to how low a temperature is beneficial. Experiments are necessary to definitely and satisfactorily settle these questions. Our impression is that, if ice is not used, there is no danger of cooling milk too suddenly or of getting it too cool. But where ice is used, especially if permitted to come in contact with the milk, or even to be separated from it only by a thickness of tin, there is danger of chilling the particles of milk in immediate contact with the cold surface, and causing them to prematurely decay. This would, of course, injure the keeping qualities of the rest of the batch. So far as the suddenness of the operation is concerned, we doubt if it would have any material effect, one way or the other. But where any portion of the milk is chilled, whether the whole batch of milk be slowly or suddenly reduced in temperature, we should expect it to injure the flavor and keeping qualities of the cheese. Some experiments, like the one made and related by Mr. FARRINGTON, of Canada, at the last Convention of the American Dairymen's Association, would seem to favor the conclusion, that suddenly reducing the milk to a low temperature is unfavorable to the production of the best quality of cheese. More experiments, as we have previously suggested, are necessary to finally settle these questions. But of the importance of cooling milk down to as low a temperature as 60° to 65°, there can be no doubt; and there need be no fear of milk being cooled rapidly enough to injure it where only water is used in the process of cooling.

CHAPTER VI.

DELIVERING MILK.

Very little attention is usually paid to carrying milk to the factory. Too many pour the hot milk into a can standing on a wagon or platform, in the broiling sun, put on the cover, which fits almost air-tight, as soon as through, and then haul it in this condition, without any shelter or protection from the sun's rays, to the factory. It is sometimes drawn two or three miles in this way. Or, as is often the case, it is left standing on the platform, covered air-tight, until the milk-wagon comes along. Whether taken on the wagon at the beginning of the route, or left standing on the platform at the last end of the route, it broils in the sun an hour or two, with the animal heat all in it. If drawn a long distance, it is pretty well churned, in addition, and thus a separation of the butter takes place which no ingenuity of the cheese-maker can remedy; but when the result is seen in the cream rising on the whey-vat, anathemas are heaped on his head. Where the milk stands quiet on the platform, the cream rises and forms an air-tight covering over the top of the milk, which soon taints next to the cream. And whether standing still or riding in a tight can, exposed to the sun's rays, without the animal heat having been expelled, it is scarcely possible to avoid taint.

In this way, the manufacturer is furnished with perhaps fifty or seventy-five messes of milk, all more or less tainted, or at least progressed in decomposition, whether any offensive odor is perceptible or not. He has these to cool off and keep over night—often with

poor facilities for cooling—for proprietors of factories are too often ignorant of the importance of providing ample means for cooling, or are too eager for large profits on small investments, to furnish them. So the operator dips and stirs away at the decomposing mass until ten or eleven o'clock, if not later, and finally yields to "tired nature's sweet restorer, balmy sleep," to rest his weary muscles and care-worn brain—exhausted, perhaps, by months of incessant toil seven days every week. By five the next morning he must be on hand, to receive the scattering messes of milk. At seven or eight o'clock comes the rush. Then the messes begin to drop off, and by half-past nine or ten o'clock the last steaming batch, with an unmistakable rotten-egg smell, makes its appearance.

Now, what has the cheese-maker got on his hands, some sweltering morning, during the season when it is "too hot to make butter," and people kindly draw their dairy liquids to the cheese-factory? Why, on rising in the morning and rubbing open his eyes, he breaks the cream on his milk. The under surface has a sickish, sour smell, which tells him very plainly that it cannot be worked up too soon. But what is he to do? The answer is plain enough: Run into this fermenting mass an equal quantity of the same hot stuff which he received the night before! What will be its condition by the time he gets through? No matter! It is his business to make cheese of it. He is employed for that purpose. If the cheese does not prove of the first quality, every patron who furnishes him stinking milk will have strong suspicions that he does not understand his business! And some even insist that the cheese-maker shall pay for all the poor cheese! But any man who is fool enough to make such an agreement, ought to

suffer, at least one season. The thought of it, however, is almost "enough to make a minister swear." And, by the way, we have been told of one instance where a minister left the pulpit and took to the cheese-factory—probably for the purpose of practically learning a lesson of patience. He was simple-minded enough to agree to pay for all the poor cheese. He soon found his salary was not equal to such a demand. So he set himself about watching the weighing-can, to keep out the bad milk. This was a Herculean task he had not counted on. We are not informed whether he swore or not; but he actually took his station outside, with a heavy rod of iron, which he was compelled to use, on one or two occasions, to keep the patrons from running rotten milk into the weighing-can! His experience was an instructive one, and ought to be a warning to all ambitious clergymen, as well as to innocent-minded cheese-makers!

We do not mean to say, that the patrons of all factories are as bad as above indicated, nor that they are no better on an average. But we do mean to say, that too many are very careless, and that almost every factory has a few patrons whose milk is apt to be in a bad condition when delivered. Besides, while we hear frequent complaints about bad milk, we never hear of any one's delivering milk in too good a condition. Patrons need have no fears of this, and may take it for granted that they cannot take too much pains with milk, both in point of cleanliness and of keeping it out of the hot sun and expelling the animal heat. We should expect to find, if a careful investigation were made, that the most unsuccessful factories are those where milk is delivered in the worst condition, while the successful ones are those where patrons are more careful and the milk

received is generally good. More often depends on the milk than on the cheese-maker. We have heard it remarked, that "almost anybody can make good cheese of perfectly sweet milk;" but it is a smart chap indeed who can make good cheese of poor milk. Every cheese-maker will appreciate our remarks, and we hope they may not be altogether lost on some patrons.

It will not, as a general thing, pay to draw milk over two or two and a half miles, for two reasons: First, it consumes too much valuable time, and next, it churns the milk too much and keeps it too long shut up tight and exposed to the hot atmosphere, if not the sun. If milk, however, were thoroughly cooled as soon as milked, and then carried on easy springs over a smooth road, there is little doubt that it might be drawn four or five miles without much injury, but the expense would be a serious objection to going so long a distance.

Cans that hold over a barrel will be found inconvenient. It is better to use two smaller ones, that can be easily handled, than one very large one. They will cost but little more, and will last considerably longer, as the strain on them will be less. A large can is made of the same material, and is but little if any stronger from additional bracing and staying, and is liable to spring aleak.

As to the use of faucets, it is generally objected to by cheese-makers, as too little pains is taken by many to keep them clean. Their use is, therefore, discarded as far as possible, and we believe cans are generally made without them. Yet, some factories still continue receiving milk through conductors, where, of course, faucets are necessary. They are also a convenience to the patron, in many instances, where the can may be used for other purposes than holding milk. It is,

therefore, not likely that their use will ever be entirely done away with. But, if neatly and smoothly put in, and care is observed in cleaning them, there can be no serious objection to them. Small faucets, however, should never be tolerated. Nothing smaller than inch-and-a-half or two-inch faucets should be put in. These are easy to clean, and greatly facilitate emptying. A small spiteful stream is a nuisance, and causes a waste of time at the factory door where expedition is what everybody wants, and is what is needed. If you use a faucet, use a large one, and keep it scrupulously clean.

CHAPTER VII.

RECEIVING MILK.

Most factories now unload milk by the use of cranes or some other kind of tipping apparatus. Some of the older factories—there are no very old ones—continue the use of conductors for transferring the milk to the weighing-can. This is the easier but the slower way, and necessitates the use of at least double the number of weighing-cans that are required by the crane. Besides, in the use of conductors, there is the constant inconvenience of standing out in the rain, in wet weather, to hold the conductor, while there is more or less liability to accident from the backing up or starting of the team. Conductors are mean, even impossible, things to clean; and their use, when there is a rush of teams, requires a second man or boy to hold them, while the first does the weighing and makes the necessary entries on the milk-book. If sixty to eighty messes are to be received, at least two weighing cans will be necessary. But by the use of a crane, one weighing-can will do the same work—always provided it has a faucet of not less than three inches in diameter, so that the can may be emptied while a team is driving up and the patron's can is being grappled and elevated ready for tipping. A large faucet is of equal advantage when conductors are used, and, in that case, every patron's can should be furnished with at least a two-inch faucet, to facilitate the transfer of milk to the weighing-can.

The use of the crane is, of course, not entirely free from accident. The strain on the can, when full, is

very great, and it is liable to spring aleak, unless well made. But cans made with reference to this use are now furnished with crowning or with patent bottoms, and are so well hooped and braced that no serious accidents of this kind are likely to occur. A can-ear, or a rope long in use, may break. There may be carelessness in hooking on to the can, and the milk may be slopped or spilled by letting a full can turn over too soon, or by too suddenly letting the milk dash into the weighing-can. All these operations require care and experience; but, with proper management, the loss from accident, during a season, will be very slight—perhaps nothing at all.

Great care should be taken in weighing milk, to not only weigh it right, but to make the patron feel that his milk is honestly weighed, and that he is likewise honestly credited on the milk-book. Much suspicion and hard feeling are liable to spring up, if the man who weighs the milk has the appearance of being hasty and careless—especially if he should be ill-natured and disagreeable in his manners. And it may not be out of place here to remark, that good manners and a spirit of accommodation are no more out of place in a cheese-factory than anywhere else. Among a large number of patrons, it would be strange if there were not disagreeable, ill-mannerly men; but a man who retains his self-possession and always acts fairly and talks reasonably, will seldom fail to get along tolerably well and retain the good will of all. It is the right of the patron to know that his milk is correctly weighed and credited, and every reasonable facility should be afforded him to satisfy himself that he is fairly dealt with.

It becomes the duty of one receiving milk to see that it is delivered in proper condition. Experience, a good

eye and a good nose, are all useful assistants. Even with the use of all these, messes will sometimes get into the vat that never ought to be there. But when a patron's milk is found not to be right, it is not necessary to insult or abuse him, nor to make a general exposure of him. Neither law nor duty requires this. He should be kindly informed of the fact, told what the matter is with his milk and what he had better do to remove the evil. If you do not wish to take the mess, you can express your regrets at his misfortune, and show him that it would cause great damage, some of which must necessarily fall on himself. If the mess is objectionable, but will pass, give him notice that you will be obliged to refuse it in future, if not in a better condition. When you have done this, more words with him are unnecessary, and you have all the advantage, for the law and the community are on your side. But, with a reasonable man, it will not be necessary to more than call his attention to the fact that his milk is bad. The cause may be the result of accident or oversight on the part of his help, and he will at once set himself to work to apply the remedy. The importance of delivering milk in good condition is more and more acknowledged every year, and not a few patrons pride themselves on delivering as good milk as any of their neighbors. It is well to encourage this feeling by giving every man credit who takes pains with his milk. Nothing is worse than wholesale denunciation and fault finding. It only discourages many, creates bad feeling, and makes an up-hill road a rough one as well. A cheese-maker needs friends, if anybody does; and if he does not get them among his patrons, he is not likely to get them at all. In that case, his seven days a week of hard, thankless toil and care are likely to weigh heavily on body and mind.

The greatest difficulty is usually experienced in old factories, where the conveniences are not generally up to the more modern mark, and patrons fell into bad habits before experience had developed a better knowledge of the requirements of cheese-making. New patrons will submit to be trained, and a sensible cheese-maker, who knows what he wants, can generally get them to do almost anything at the opening of a new factory. In this way, he can discipline them and get them in the habit of taking good care of their milk. But, in an old factory, where everything started off badly, the old adage, that "it is hard to learn old dogs new tricks," is apt to be exemplified. They dislike innovations, think a new man, who wants to be particular, wishes to put them to useless trouble, and they are not disposed to gratify him, but rather to growl at him, and feel that what was good enough for others is good enough for him. Such conduct is all wrong, and those who are guilty of it stand in their own light.

CHAPTER VIII.

BIG AVERAGES.

It is the custom in many factories to balance the scales so that a pound or so is taken out of each mess, in order to help make "a big average" for the season. That is, every mess is made to weigh a pound or so less than its actual weight, and is so entered on the book. In this way, if sixty or seventy messes are received, the cheese-maker has that number of pounds of milk more to make up than is charged against him. This amount twice a day would enable him to turn out some twelve or fourteen pounds of cheese more than he ought to if he received no more pounds of milk than he gives credit for on the milk-book. Thus he makes it appear to the patrons, and publishes it ultimately to the world, that he uses less pounds of milk in making a pound of cheese than is the actual fact. In common phrase, he "makes a big average."

Let us illustrate a little. Suppose ten hundred and ten pounds of milk are delivered in ten messes. The entry on the book is one thousand pounds. Out of this he makes one hundred and one pounds of cured cheese. If the milk had been correctly weighed, the fact would appear that he made one pound of marketable cheese for every ten pounds of milk. But it really appears that it took a fraction less than ten pounds of milk, or 9.9 pounds, for a pound of cheese. This is the advantage which he has, in the eyes of the community, over the maker who gives honest weight. This is the reward of his petty dishonesty.

In justification of this, it is argued that it keeps up

not only the reputation of the maker but the reputation of the factory, while it wrongs no one, since the patrons get all the cheese, or its equivalent in money, and all are served alike. We admit that the patrons get all the products of the milk, but let us see for a moment whether all are treated fairly. Every patron has a pound of milk deducted from each mess. SMITH brings a hundred pound mess, and is therefore docked one hundredth part of it. JONES, with only one cow, delivers a ten pound mess, and is docked one-tenth of it. Thus, at the end of thirty days, each has delivered sixty messes. SMITH has delivered 6,000 pounds and been credited for 5,940. JONES has delivered 600 pounds, and got credit for 540. If ten pounds of milk make one pound of cheese, the account ought to stand thus:

Smith, 6000 lbs. milk,	600 lbs. cheese.
Jones, 600 lbs. milk,	60 lbs. cheese.
Total,	660

But, under the system of deducting a pound from each mess, in order to show a "big average," the account really stands thus:

Smith, 5,940 lbs. milk,	605 lbs. cheese.
Jones, 540 lbs. milk,	55 lbs. cheese.
Total,	660

At twenty cents a pound for cheese, JONES, because he is poor and delivers a small mess, loses just one dollar on his month's milk, and SMITH, because he is better off and has a bigger mess, gets the dollar added to his profits. This, in plain figures, is the result of deducting weight in order to show a "big average." Let no one who reads this do it again. He can no

longer plead ignorance, and continue to rob PETER for the benefit of PAUL, under the supposition that he is treating all alike and fairly.

Unquestionably, something should be allowed for the difference between a dry and a wet can. The amount is trifling, and can be got at by balancing the scales immediately after running out a can of milk. But, when the scales are balanced with a wet can, they will not balance exactly when the can is dry ; and whoever delivers the first mess and wets the can will suffer a slight loss, unless care is taken to give good weight. The variation will generally not be more than a quarter of a pound or so, and can be nearly enough approximated by attention to the fractions of a pound denoted by the scales.

Of course, in weighing milk, only the full pounds can be counted and credited, the fractions going to make up full weight. As quick weight is demanded in selling cheese, milk when received should be weighed in the same way. This is fair, and ought to be satisfactory to all. But whether quick or slow weight is given, let it be honest. In the long run, "honesty is the best policy" in weighing milk as well as in other transactions; and, in this case, it is absolutely essential to justice. A little deduction or variation on a single mess, is of small consequence; but "many mickles make a muckle," and when the variation from a correct standard is constantly in one direction, after a while it amounts to a noticeable quantity.

Occasionally a mess of milk will get run into the vat without weighing, by the weigher forgetting to close the gate or faucet. When an accident of this kind happens, there is no fairer way than to give credit for an average mess as compared with the messes at the

same time of day previously. If the patron is a fair man, there will be little trouble in hitting upon a satisfactory figure. If disposed to make the most of a mistake, he will be likely to tell you that he thought he had a larger mess than usual, and crowd you up to as high a figure as possible. But one has to exercise his best judgment, and give such credit as he thinks will wrong no one. Such mistakes, though almost unavoidable, are unpleasant to one who is sensitive and wishes to keep the good side of all; and not only care should be taken, but every precaution should be used, to prevent them. The handle or lever for closing the gate should be in full sight, and one should acquire the habit of working systematically, so that he may instinctively do what is necessary, even though his attention be for the moment diverted from his business.

Great care is required, too, in making the entries in the milk book. A mess, by carelessness, may be credited to the wrong man; but when the man to whom the credit is wrongfully given presents himself, the mistake is likely to be discovered, though you may not be able to determine at once to whom the credit belongs. In such case, preserve the figures, and when your messes are all in, turn over the leaves of the book and see who is without credit. The size of the mess is generally some indication. One is liable, too, to make a mistake of fifty or a hundred pounds in looking at the scales. But the habit of comparing every entry with the previous ones as you make it, will show the discrepancy. Where such variation is noticed, of course another glance at the weight will determine whether it is a mistake or not. It is a very good practice to call out the weight of each mess. This affords satisfaction to the patron as well as guards against allowing errors

to pass. But, under all circumstances, too much attention cannot be paid to keeping the milk-book correctly. It is the only guide to the distribution of the proceeds of the factory, and the thought of even a possible mistake ought to give an honest man a strong sense of responsibility. No bank book is of more importance.

CHAPTER IX.

CONDUCTORS, STRAINERS, ETC.

When treating of receiving milk, we spake of conductors as difficult to clean. We consider them an abomination in a cheese factory; yet almost every factory uses them. We believe there are some, however, arranged for delivering and receiving milk by driving through one end of the factory. The milk is brought in small cans, out of which it is poured into the weighing-can by hand. The weighing-can is on a truck running on a railway along the sides or ends of the vats, into which the milk is readily emptied by tipping. This does away with both faucets and conductors, and the idea is worthy the attention of all factorymen.

When cranes are used in receiving milk, the outside conductors are not needed, but there are two or three long conductors, inside the factory, used for running the milk from the weighing-can into the vats. Sometimes we see one of these tin tubes ten or fifteen feet long. It is impossible to keep such a thing clean. A peep into this, or shorter ones, will show that they are not kept clean. Take as much pains as the hands may to clean them with a swab on a long stick, they will soon get coated over inside by the milk drying on; and, unless extra pains is taken, they will be lined with a beautiful coating of green and gold! They are used at night, and, unless the weather is very bad—and many pay no attention to the weather—they are allowed to stand over night where used, ready for the next morning. The milk and cream get dried on the

inside surface, and nobody has the time, if the disposition, to soak it off. Further, tin conductors will get dents in them. The milk will collect and dry in the angles made by these dents. How, in the name of common sense, can any one get at them to clean them, in a tube ten or even four feet long? It is an impossibility. The milk collects, from day to day, until the conductor is full of foul ferments, through which all the milk of the factory is run and tainted. It is no fault of the cheese-maker, because he can't help it, if he employs a hand constantly on these abominable tubes. He may use a swab with strong ley, or salt and water, or both, and run hot water through the tubes till the patrons begin to come with their milk, but the "damned spots" will not "out." Of course, he will somewhat neutralize their active properties as ferments, but he does not altogether get rid of them. The only way in which he can do it, is to pitch the nasty things out of the window.

If conductors must be used—and their use seems to be a foregone conclusion—let them be made in the form of open spouts. A foot or so next to the head, is all the tube that is needed—and this should be large enough to readily admit the hand for the purpose of washing. The rest should be an open spout, which can be easily and speedily cleaned and scalded. Many owners of factories, however, are too penurious to spend a few dollars in order to get rid of this nuisance of long tin conductors. They would rather lose—or, at least, run the risk of losing—five hundred dollars on the sale of their cheese, than spend five dollars for the purpose of avoiding this fruitful source of taint. If the cheese is poor, the blame can be laid on the cheese-maker; or, if the taint is too manifest in the vat of milk or curd, it can be charged upon the carelessness of the patrons.

There is another source of trouble, which lies entirely with the cheese-maker, or with the hands under him whom he trusts. This is the strainer. In cool weather, perhaps there will be no difficulty, if the strainer is properly washed, scalded and dried each morning after the milk is all in. But in hot weather, especially if the atmosphere is damp and steamy, if a strainer is left over night without rinsing, it is sure to sour. Yet, the strainer, like the conductor, is often left at night just as used, ready for the reception of the next morning's milk. Both are likely to be sour. The milk in the vat is "old," especially next the cream, which acts as an air-tight covering. Now, run hot milk through the sour can, conductor and strainer, into this mess of changed milk, and any one, with even but a modicum of brains, can see what is likely to be the consequence. It will be a batch of sour, leaky cheese.

Where an agitator is used, the trouble of milk souring or tainting beneath an air-tight covering of cream, is obviated. Washing cans, conductors and strainers at night, gets rid of the difficulty from these sources—that is, as far as the can and strainer are concerned, and partially as regards the conductor. A thorough rinsing in cold water, immediately after the last mess is run in, will be found to answer the purpose. It is usually late, and there is no hot water for regular washing and scalding. But a few moments' work will complete the rinsing in cold water, and this will not be found a very hard task for even the jaded hands of a cheese-factory. During all the hot weather, this should be strictly attended to. It will pay in a double sense—it will prevent sourness, and make the can, conductor and strainer easier to wash the next day.

The old-fashioned thermometer is also a source of

annoyance, if care is not taken in cleaning it. It will fill up with ferments between the face and back, in an astonishingly short space of time, during hot weather. In short, there is no way of keeping it perfectly clean, except by slipping the thermometer out of the back or case, and carefully washing and scalding it—and in doing this, it is exceedingly liable to get broken. We are therefore glad to notice the introduction of a new thermometer for dairy purposes. It is simply constructed, plain, easy to clean, and no more expensive than the common kind now in use. Those in need of thermometers will find this style much better adapted to their uses. The glass is fastened to a plain plate of metal, the two edges of which are bent forward to give it the requisite stiffness.

Of course, agitators, dippers, rakes, &c., need to be carefully cleaned. But we have before spoken of the importance of the most scrupulous attention to cleanliness throughout, on the part of the cheese-maker as well as of the patron. Cleanliness is an indispensable virtue in all departments of dairying.

CHAPTER X.

COLOR.

One would hardly think of associating cheese-making with the fine arts; yet, in what other light can we view the subject of color? It adds nothing to the quality of the cheese, but rather detracts from it. It is expensive and troublesome, and grows more so every year, as the demand for annotto runs up the price and leads to adulteration. But as long as we make cheese for a foreign market, we must adapt our goods to the tastes of that market, whether they be physical or mental. Our home market would, perhaps, not suffer from the omission of color; but the English market demands, to a large extent, highly-colored cheese. The Liverpool market will take a small quantity of pale cheese, but it does not equal more than one-fifth of the demand of the English market. A few factories, which sell exclusively to buyers who supply the Liverpool demand for pale cheese, may safely omit the color; but all which depend on the general market cannot safely do so. The London market specially demands a high color, and it is no less exacting now than it has been heretofore. The cry of buyers generally is, "Keep up the color!" The exceptions to this are few, and are confined to those who have special orders for pale cheese to supply the demand above indicated.

The English consumer acquired his taste for golden-hued cheese before the American make found any considerable market abroad—indeed, before we had much cheese to sell. The first object in coloring seems to have been to give a rich butter color. In this way,

cheese was made to appear rich whether it really was so or not. But the shade has been considerably intensified and the English eye is best pleased with the color produced by the use of prime annotto, with which it has become familiar. This may be a prejudice, but it is a comparatively harmless one; and since our customer is willing to pay for it, there seems to be no good reason why it should not be gratified. It is for our interest to please the eye as well as the appetite of so large a buyer of our products as England. She wants about four-fifths of her cheese highly but nicely colored.

The complaint among buyers generally is, that color is too low. In reply to suggestions about the fact, makers often say that they never used more coloring, but it does not produce the desired effect. They have paid a high price for what was supposed to be prime annotto, but it proves to be extensively adulterated, and therefore weak. This is not the complaint of all, but of many. Some have adopted the use of prepared annotto, and find it cheaper and more satisfactory. When prime annotto could readily be had, it was cheaper to buy the basket and prepare it themselves. But now, one poor basket, during a season, imposes a loss greater than the difference in price between the prepared and the unprepared.

There is another evil about the use of poor annotto. It is not only expensive and does not give the desired color, but what color it does give fades out with age, and leaves the cheese with a cloudy, mottled appearance, which is very offensive to the eye of our best customers. Again, where poor annotto is bought in the basket and prepared at the factory, it contains a large amount of sediment, and this sediment, often con-

taining deleterious substances, too frequently gets into the cheese. The liquid is not properly settled and racked off. This affords another argument in favor of buying prepared annotto, which, if properly put up, is free from sediment.

Those who prefer to buy the basket annotto and prepare it themselves, should buy only on the warrant of the dealer that it is what it is recommended to be. The dealer should test a sample of his annotto, before offering it for sale, and know precisely what he is selling. Buyers by thus purchasing only of well-known dealers, who sell upon honor, will discourage rascality. This is the only method we see for keeping the spurious article out of market, and securing satisfactory results in coloring.

We would suggest to those who prepare their own annotto, that they use concentrated ley or potash. By doing so, they will secure just as good a shade as they can by using ley from wood-ashes, and not only save the trouble of bothering with a leach, but secure uniform strength. Two leaches will seldom turn out ley of the same strength. Sometimes it will be strong and satisfactory. But if you happen to get a lot of soft wood ashes in your leach, the ley will be weak, imperfectly dissolve the annotto, and materially injure the liquid.

In fact, it is difficult to get your coloring twice alike by the use of a common leach. But with concentrated ley or potash, the same quantities or proportions of materials, mixed in the same way, will produce the same result. You can therefore keep your color even, and will not be called upon to experiment and change your hand every time you prepare a new batch of annotto. The difference in expense will be trifling,

and rather in favor of the use of potash, if time and trouble are counted of any value.

The prepared annotto ought to be kept in a stone jar, as the ley operates injuriously upon wood, and is liable to leave a tub in a leaky condition as the liquid is used out and the tub dries. Where annotto is purchased already prepared, of course it comes in vessels suitable to keep it in; but when prepared at the factory, a receptacle has to be provided, and nothing is better than stone or earthen-ware. In hot weather, the liquid is liable to smell badly from the action of the heat on it. A little salt stirred in will be found useful as a preventive against this.

It is not necessary to discuss at length the question of the effect of coloring on the quality of the cheese. The introduction of a strong alkaline preparation cannot be without some effect; and when that happens to be adulterated with some vile substance, the effect cannot be otherwise than injurious. The annotto itself is generally conceded to be harmless; and the ley is, at most, but a neutralizer of the lactic acid, but the quantity is not sufficient, perhaps, to produce any perceptible result. At all events, color is demanded; annotto, prepared with ley or potash, is the accepted material; so we have only to color with annotto to suit the taste of our customer.

We are assured that nicely colored cheese will bring from a cent to a cent and a half a pound more than the same quality of cheese will bring when pale. Buyers in some instances advise the making of pale cheese because they have a special order for it; but they usually expect to get it a little under the highest market quotations, and factorymen who allow themselves to drop the color on the advice of an interested buyer, because

it is easy and costs nothing directly to do so, run the risk of being caught and of losing a great deal more than they can save by omitting the coloring. We never heard of a lot of cheese being condemned because it was too nicely colored; but we frequently hear of complaints and losses because cheese is too pale. The chances are at least four to one in favor of high-colored cheese; and even the fifth chance is not positively against color, though the other four are strongly against *lack* of color. He who wishes to have the widest range of markets, and to command the best markets, must pay strict attention to color—not only must he color, but color well and evenly.

We have an objection to color, for reasons satisfactory to ourselves; and buyers can have no interest in inducing makers to color their cheese, beyond the fact that it makes it more marketable—and in this, patrons and factorymen have a much greater interest than dealers can have. The market demands a rich, even color, and will not be satisfied without it. We say, therefore, *as a matter of dollars and cents*—not of taste, choice or convenience—*keep up the color.*

We will give two recipes for preparing annotto: 1. To five pounds of prime annotto put five gallons of strong ley, made from wood ashes; gradually heat up and dissolve the annotto, care being taken to not scorch it on the bottom of the kettle. Of course thorough stirring is essential. When the annotto is all dissolved, add five pounds of sal soda and five gallons of soft water. Then gently boil the whole for twenty or thirty minutes. This makes about ten gallons of prepared coloring. If boiled away to less, add sufficient ley and soft water, in equal quantities, to make that amount. Some omit the sal soda; but it is generally believed

that it not only adds strength to the preparation, but improves the color by giving it more of a rich, buttery hue, instead of a red. The whole, when sufficiently cooled to handle safely, should be set in a tub, with a faucet two or three inches from the bottom, to settle. When settled, it can be drawn off, and is ready for use.

2. Mix in the proportion of five quarts of water to half a pound of concentrated ley, and one pound of prime annotto. First dissolve the ley in the water, by heating and stirring, and then add the annotto, and dissolve it. Boil gently for half an hour. Care, as with the other preparation, should be taken not to burn it. Settle and rack off. Then your liquid is ready for use.

The second recipe is the one most used, and is easiest to prepare, as it avoids the labor, perplexity and risk of making the ley, which may not always be of the desired strength, as the ashes may not be the same. But if ashes are used, hot water is best to leech through them. A quart of salt to ten gallons of preparation will improve its keeping qualities.

CHAPTER XI.

RENNET.

An indispensable requisite in making cheese is good rennet. Nothing else will answer the purpose. Different subsitutes have from time to time been tried, but all have met with indifferent success, or absolutely failed. Acids will produce coagulation, but they spoil the quality of the cheese. It was once supposed that the gastric juice of the calve's stomach was acid, and produced coagulation by souring. But it has been demonstrated that good curd can be produced from sweet new milk, by the use of rennet, without the development of acid in either the curd or the whey. How or why the principle obtained by soaking the calve's stomach produces coagulation has not yet been discovered. What the principle *is*, is not even known. It appears to be contained in the gastric juice secreted by the inner membranes of the stomach, and a small quantity of rennet, stirred into a vat of milk, seems to coagulate it in the same manner that milk taken into the calve's stomach is coagulated. We all know the fact that by the use of rennet we can make cheese. Beyond this, we have little knowledge; so far as we are aware, scientific men are just as much in the dark as the cheese-maker.

As the stomach of the calf is bifold, we have seen the mistake frequently made of saving the wrong one. But we presume patrons are generally well informed on this point now, after so many years' experience. Where the stomach is not entirely empty, the presence of curd is a sure guide. Always save the stomach that con-

tains the curd, and no mistake will be made. If the stomach is empty, save the one that has a smooth inside surface. The one that has a rough, honey-comb-like inside surface is worthless for cheese-making, and should, of course, be rejected.

There are three or four ways of preserving the rennet or stomach, for future use. Only two, we believe, are generally practiced in America. In all cases, the rennet is to be turned wrong side out, all its contents being thrown away, and the inner surface carefully cleaned by picking off all hairs and bits of grass, hay or other substance which the calf may have taken into its stomach. But the rennet should never be washed, and great care should be taken not to remove any of the inner membrane of the rennet, as in this membrane resides all its strength. Washing would rinse out the gastric juice, and weaken the rennet; and much washing would render it nearly or quite worthless.

When properly cleaned, the rennet should be thoroughly rubbed with salt, outside and in, turned the right side out, stretched on a crotched stick or on a hoop, and hung up in a cool, dry place, to cure. In private dairies, the farmer's wife, after salting the rennet, sometimes spreads it on an earthen plate and sets it away to dry, frequently turning it on the plate. Rennets dried in this way are nice, but it is too much work to tend to them for a general adoption of this method of drying. Drying on a stick or a hoop is the common way, and answers the purpose very well. The only trouble is to find a place both dry and cool. It is generally conceded, we believe, that heat injures the strength of the rennet. Hence the importance of curing it in a cool place. Freezing is thought by many to add to or develop the strength of the rennet. Be this as it may,

old rennets, that have hung up in the dry-house or some other convenient place through the winter, will go much further in cheese-making than new rennets.

Another method of preserving rennets is by packing them into salt. This is quite common, and is practiced by some of our best factories. It is less troublesome than drying them, and is a sure preventive against moths, which are apt to get into dried rennets. By salting them down, there is less trouble to find a cool place in which to keep them during the summer. But care should be taken to use only the purest salt in packing rennets. Salt not fit to salt curd with is not fit to pack rennets in, for when the rennets are used, the salt will be in the liquid and find its way into the mass of curd. Besides, pure salt is much the better preservative, and will keep either meat or rennets sweeter than impure salt.

Some think rennets preserved in this way are not as strong as those that are dried. We do not quite see the philosophy of this, since by packing in salt, none of the virtues of the rennet can escape by evaporation, and must be retained either in the rennet or in the salt. It may be said that the salt injures the strength of the rennet. If so, why does it not prove equally injurious when the rennet is dried? In both methods of preserving, salt is freely used—generally all that the rennet will absorb. A batch of dried rennets may go farther than the same number packed in salt, and *vice versa;* but this does not prove that the *same* rennets would not have equal virtues preserved by either method.

The German method of preserving rennets is by blowing them up like a bladder, and drying them. This is the way in which the Bavarian rennets, which

reach this country, are preserved. We believe no salt is used. The method is simple, and if it answers the purpose equally well, we see not why it may not be adopted in this country. We understand that the Bavarian rennets give very good satisfaction. But, as we have never used them, nor seen them used, we cannot speak from positive knowledge.

Veal rennets are generally supposed to be better than deacon rennets. Certain it is that the stomach of a calf that never sucked the cow is not worth much in cheese-making. It is both small and weak. It seems to be necessary that the process of digestion should go on for a while, at least, that all the functions of the animal may become active and a full secretion of gastric juice take place. Some are of the opinion that the rennet is best when the calf is from three to five days old, as at that age it is not likely to have taken anything but milk into its stomach, which is best prepared for digesting that kind of food, the first process of which is coagulation. Veal calves are apt to get hold of other food, and the stomach is therefore less exclusively adapted to a milk diet. Hence, it is argued, if the veal rennet is better than the deacon, the stomach of the cow or ox ought to be better than that of the veal calf. Whatever may be the conclusion, we have, and shall probably continue to have, both deacon and veal rennets, both kinds of which have been found to work satisfactorily.

Much seems to depend on the condition of the calf when killed. If it goes too long without food, the stomach gets inflamed and is not only deprived of its strength, but is partially diseased, and, therefore, unfit for cheese-making. This is the condition of most of the rennets taken from calves killed in our larger cities,

the calves going without food sometimes two or three days. On the other hand, when the calf has a full stomach, the juices seem to be absorbed in the food, and the rennet is, therefore, weak. The best time for killing the calf appears to be just after the stomach has emptied itself, when the appetite of the calf begins to be sharp and the secretions of gastric juice are copious. This will generally be found from twelve to eighteen hours after eating. If fed at night, it may be killed any time the next forenoon.

CHAPTER XII.

PREPARING RENNET.

The process of preparing rennet for use is very simple, and so generally understood that we need not more than give a few hints on the subject. In putting rennets to soak, care should be taken not to allow any tainted ones to get into the batch. When they are packed in salt, it is not difficult to make a selection. If the poor rennet does not smell, it will be pretty likely to be discolored and unhealthful looking, instead of having a whitish, wholesome appearance. All rennets thus discolored should be thrown away as worse than useless—as positively injurious. If the rennets are dried, it may not be so easy to detect the poor ones before putting them to soak. After soaking, their quality will be quite apparent; but much of their injurious effect may be avoided by promptly rejecting them without rubbing. It is generally, and we believe correctly, understood that diseased or tainted rennets produce both huffy and bad-keeping cheese, by the introduction of decayed animal substances. It certainly cannot improve the quality of the cheese to mix with it the broth of carrion.

Clear whey is the common and best liquid for soaking rennets. Water was once and is now sometimes used, but it needs to be very soft and pure, and is improved by boiling. We have never tried water, but it is asserted by those who have used it for soaking rennets that a batch prepared with it will not keep sweet as long as one prepared with whey, but that boiling the water keeps it sweet longer than it will keep if not

boiled. We think the purer the whey the better, and therefore prefer that which first separates from the curd after setting. Some are not particular, and some prefer the salt whey that runs from the presses. There is a saving of salt in this, but we think this liquid cannot be as good to introduce into milk as that containing less cheesy and buttery particles. Boiling the whey and skimming it, afterward allowing it to cool and settle, that the sediment may also be excluded, is said to be a great improvement, and we can easily believe this to be true. It is not only free from impurities, but it forms a sharp acid that acts readily upon the rennets and extracts more completely the pepsin, gastric juice, or whatever it may be that coagulates the milk. It is said that quite a saving in rennets can be effected by using scalded whey for soaking them.

Twenty or twenty-five prime rennets put into a half barrel of whey will make a good preparation. It can be made stronger, of course, by the addition of more rennets, or pouring in a less amount of whey; but it is questionable if the entire strength can be extracted by using a less quantity of whey in proportion to the number of rennets. They need to be rubbed at least three times, each time in a new batch of whey. The second time the preparation will be found about as strong as the first. The third rubbing and rinsing may be in fresh whey to be used for soaking a new batch of rennets. We like to have two tubs or jars for soaking the rennets, one for the first and the other for the second rubbing, alternately. After rubbing the second time, put the rennets in a sack made of strainer cloth, to keep them separate, and soak them with the batch intended for the next second rubbing. In this way the strength of the preparation from the batch may be

kept equal to that from the first. Rub the third time, and rinse in fresh whey, as before indicated, when the strength will be found pretty completely extracted. If dried rennets are used, it will be necessary to add salt to the whey when the batch is put to soak. Every time new whey is added, more salt will be required. Where the rennets are packed in salt there will usually be salt enough for the first soaking adhering to them; if not, it may be increased in quantity by a few handfuls of that loose in the barrel in which they have been packed. As the rennets will float on the whey, they should be thoroughly stirred up as often as night and morning, and a little salt sprinkled over those left on the top.

We prefer stone jars, both for soaking rennets and to keep the prepared rennet in, because they are so much more easily kept sweet than wooden tubs can be. Of all things, we detest a stinking rennet tub or jar. Frequent scalding, when emptied, is necessary. When the preparation is kept in a tub, it will be advantageous to rub a little salt, each morning, on the sides of the tub left exposed to the air, after setting the milk, by the lowering of the liquid. By all means, do anything and everything that may be necessary to keep the rennet tubs or jars from stinking so badly that the stench will nearly suffocate one on uncovering them. A sweet rennet tub is the evidence of important qualities in a cheese-maker—care and cleanliness.

Of course, there are various ways of managing, as regards quantity, convenience's sake, and so on, but we do not believe the principles involved in the process of selecting and preparing rennets for use, as we have given it, can be violated or neglected without loss in some manner. The importance of properly-prepared

rennet, and of keeping it sweet and clean, cannot be too highly estimated. "Bad luck" in cheese-making might not infrequently be traced to the rennet tub; while "good luck" may be as often traced to the same source. Look out for your rennets and take care of your rennet-tubs or jars. They may make or mar your fortune.

CHAPTER XIII.

SETTING.

The temperature of 82° to 86° is generally considered the best for setting—the former in hot and the latter in cold weather. This gives an average of 84° for mild weather. Perhaps this point is as good as any for setting. But it is worth bearing in mind that the milk will coagulate sooner, after adding the rennet, at a high than at a low temperature. The same milk will set quicker at 86° than at 82°, and at the points in the vat where the heat is greatest, or the milk cools least by radiation, the curd will become tough and difficult to cut, while other parts of the mass will remain tender and cut easily. This not only demonstrates the greater activity of the rennet at a higher heat, but the importance of an even heat throughout, and of keeping it from falling. Some throw a cloth over the vat, after the milk begins to thicken and agitation is no longer necessary to keep the cream from rising. This is a good practice, we believe, as it retards the reduction of temperature by radiation, and keeps the heat more equalized. This will secure a more uniform action of the rennet, and render the cutting less difficult and less liable to cause waste.

When the rennet is once added and thoroughly incorporated with the milk, we believe it would be better if the mass could have perfect rest until the curd is ready to cut. We think the curd is more likely to be spongy in consequence of the continued or frequent agitation kept up to prevent the cream from rising. All know that a stir too much after the milk begins to

look thick, and roll heavily, prevents the formation of a solid curd. It refuses to unite in one uniform mass, and remains in small, separate particles. But, when the milk is all right, observation will show that such a curd makes fine cheese, though there is great waste from the fine particles floating off with the whey. And why will it make fine cheese? Because it is in small particles, gets thoroughly and evenly cooked, and the butter is equally distributed through it.

But the difficulty of preventing the cream from rising and forming a cream-curd, that will float on the whey, if it does not waste, needs to be overcome before we can allow the milk perfect rest after incorporating the rennet. We are not aware of any method for accomplishing this. Agitation of the surface, at least, seems necessary to retain the cream; but if the surface only is agitated, manifestly the cream will escape from the bottom of the mass and impoverish it while enriching the top. A thorough stirring of the whole mass, therefore, will keep the cream more equally distributed, and it will also secure a greater uniformity of temperature. The cheese must be of evener texture than if made of curd of different degrees of richness mixed together.

It is a question for debate as to whether the cream which rises on milk is thoroughly incorporated with it by stirring. That butter is wasted in making cheese, is a fact that cannot be denied. Some think that nearly all the cream that rises on the vat during the night is floated off in the whey. We cannot indorse this conclusion, although it is asserted that where agitators are used, and the cream is thus prevented from rising, there is a great saving of the butter. But one fact is worth a thousand fictions in the practical affairs of life, whatever it be in romance. Cream will mix with the

milk by stirring, and go to enrich the cheese, as is proved in the manufacture of the English Stilton cheese. In the manufacture of this, the cream of the night's milk is taken off and added to the morning's milk, which is worked up separately. The cheese is greatly enriched thereby. How much the waste of butter is increased, we are unable to say. We know from our own experience, that skimming the night's milk, instead of stirring in the cream, makes a marked difference in the yield and quality of the make.

The first thing in setting, when a vat of milk is raised to the proper temperature, is to add the coloring. This is a strong alkaline preparation, and must have a tendency to retard the development of the lactic acid, if it does not combine with it in forming a neutral salt. If no effect is perceptible, beyond the color it imparts, it is simply because the quantity is so small. Probably the effect of the alkali in the annotto is more than counteracted by the acid in the rennet.

Nothing as good as clear whey has been found for soaking rennets. Some think the acid an advantage in the working of the milk, and others go so far as to add, in cold weather, a quantity of sharp whey to the milk along with that in the prepared rennet. This, of course, hastens the development of acid throughout the mass. But we cannot say that we approve of doing anything to change the milk, and thus sour the curd before cooking. We prefer to have the milk as sweet as possible when set, and to keep the curd sweet until it is cooked. Then we would develop the acid in the whey. For this reason, if sour whey is to be added, we should add it after the curd is cooked, for the purpose of hastening the development of the lactic acid in the whey. This seems to us to be the most rational

course, from what our experience has taught us. If fair experiment should demonstrate that we are in error as to when and where the development of the acid should take place, we shall be willing to yield the point.

The amount of prepared rennet that it is necessary to add to the milk, depends upon its strength, which can be determined only by experiment. Sufficient should be used to coagulate the milk in ten or fifteen minutes, and render it fit to cut in thirty or forty minutes. If the milk is "old," the same quantity of rennet will cause it to work sooner, as it should. Some would add less rennet. We would not. The milk needs to work faster, and the acid, although it coagulates the milk, will not supply the place of the rennet. The rennet ought to be strong enough to require not more than a quart to a thousand pounds of milk.

CHAPTER XIV.

CUTTING CURDS.

Cheese-making was once carried on without cutting the curd; and even since the introduction of the factory system, there have been those who denounced the idea of using a cutting instrument. Breaking up the curd with the hands was considered the better method as incurring less waste, both of butter and cheese. Such ideas, though entertained but a few years ago, are obsolete. Cutting curds is now universal, certainly in America. The only questions are as to the time, manner and extent of cutting.

When should the curd be cut? Practically, there is little difference of opinion on this question. Some may cut a little sooner or later than others, and even the same person may not always be precise as to the time of cutting. But all will agree that a curd should not be cut before it is firm enough to break square and smooth over the finger without whitening the whey; and they will also agree that it should be cut before it gets tough enough to drive along ahead of the knife. We would cut it as soon as it can be done without waste, while the curd is tender; and we would do all the cutting at once. There is no sense in running the knife through the curd one way, and then letting the curd stand andtoughen before cross-cutting and completing the operation. If it is fit to partly cut, it is fit to wholly cut; and the sooner the cutting is done with, the better. Time for the separation of the whey can be given after the cutting is done, and before the heat is further raised.

The cutting should be done as carefully as possible and as evenly as possible. The fewer the motions, the better. If it could be done instantaneously and uniformly, without agitation, it would be an advantage. At the right time, we would like to have the entire vat of curd instantaneously separated into pieces of uniform size. This is the end to be aimed at. We are far from reaching it with present appliances. We can only approximate it as nearly as possible. A knife, therefore, with blades near together is preferable to one with blades farther apart.

As to the extent of the cutting, there is more difference of opinion, though the difference has much diminished since the mania for coarse curds ran its course. A few yet cling to this exploded notion; but the great majority choose a medium degree of fineness. It has been found that the large pieces do not sufficiently cook, especially if the milk is old enough to work quick. The consequence is an uneven texture, and a deteriorated flavor. Sufficient whey remains in the centers of the large lumps to ferment and give the cheese the smell of the whey-vat, if it does not sour and cause the cheese to become leaky and dry. Possibly, if the weather be favorable for curing, the whey may collect in pungent drops throughout the cheese, showing themselves when cut somewhat as they do in the Limburger. Such cheese, we think, is likely to ultimately approximate the Limburger in both odor and flavor. It will please some tastes, but will not answer for the best markets.

Medium curds are now the rule. As cheese-makers have approximated fine curds, they have improved the quality of their cheese. We believe still finer cutting will prove a further advantage. We will give our

reasons for thinking so, and will add that our experience, as far as it goes, corroborates the idea. It secures a more uniform action of the heat and separation of the whey, and therefore an evener texture and better flavor, with correspondingly improved keeping qualities.

What is the object and advantage of cutting at all? Why not let the curd remain in one unbroken mass? We cut the curd for the purpose of facilitating the separation of the fluids from the solids by the combined action of the rennet and heat. Is it not desirable that this action should be uniform on every particle of curd? We think this question will be generally answered in the affirmative. If so, then it must be conceded that the finer the curd is cut the more nearly the desired result will be attained. If it could be separated particle from particle, without waste, would not the action of the heat and rennet be more perfect still? When in lumps, the externals of them must necessarily be cooked more than the centers, and the evil of over-cooking—if there is such an evil with a blood heat temperature—is illy counteracted by the mixture of curd cooked to different degrees—some overdone and some underdone. It should all be cooked alike, to whatever degree the cooking may be carried. This will secure uniformity of texture and quality, and also clean flavor, if the cooking is complete.

But, of course, in cutting a curd fine there is danger of waste—waste of curd, but not necessarily waste of butter, unless the curd is sour. Then it is impossible to avoid waste of butter by any process that we are aware of—and with a sour curd there is all the more necessity for cutting fine and cooking rapidly and thoroughly. With proper care, the evil of sour milk can be avoided. With good sweet milk and proper management, there

is very little danger of waste of any kind, cut as fine as we can with the common knife.

We would cut so that the pieces when cooked should not be larger than kernels of corn; and though many object to it, we should not, if the pieces were as small as buckwheat—and as regular in size. We would not use a knife with the blades more than a quarter of an inch apart. Though we have never used a knife for cutting horizontally, the idea commends itself to our judgment. We would carefully cut first with the horizontal knife, leaving the thin slabs of curd lying one upon the other. Then, without waiting for the whey to rise or the curd to sink, we would use the perpendicular blades lengthwise of the vat, reducing the slabs to long square strips, and follow this with the cross-cutting until the pieces were at least as small as beechnuts. After this, the curd may be allowed to stand a few minutes, for the whey to separate, before starting the heat—provided the milk is sweet enough to permit of delay. But if the milk should give any indication of being old, we would begin at once to gradually raise the heat; if quite old and changed, we would crowd the heat as fast as practicable.

To sum up in brief, we would cut a curd and complete the cutting as soon as it can be done without waste; we would cut it as expeditiously as possible and with as few motions; we would cut it as fine as care against waste would warrant; we would raise the heat as gradually and evenly as circumstances would permit; we would cook as thoroughly and as evenly as possible; we would keep up the heat until the curd is done; we would then let the acid develop in the whey until it is plainly changed; we would dip as warm as convenient, drain and salt, cool to at least 80°, and then put to

press. With good milk, good rennet and a good place to cure the cheese in, we should expect in this way to turn out a tip-top article.

CHAPTER XV.

HEAT.

One of the most important elements in cheese-making is heat; but we do not believe the importance of its proper regulation is sufficiently understood by our cheese-makers. We are aware that cheese can be made without the use of artificial heat. It is not such an article, however, as would meet with a ready sale, or be likely to increase the consumptive demand for cheese. A good-keeping, mild and nutty-flavored cheese cannot readily be produced, if at all, with a temperature lower than 96°; nor can a rich, buttery article be made with a temperature over 102°. We consider 6° the widest allowable range of heat, and think 98° to 100°, or full blood-heat, the best temperature.

Evenness and steadiness of temperature are two important points. That apparatus is best which heats the milk throughout the vat the most evenly—leaves it the freest from hot places and cold places, at the sides, ends, or on the bottom. A perfect apparatus would raise the temperature of every particle of milk at the same time and at the same rate; and retain this perfectly even heat at the desired point until the cooking is completed.

The difficulty, with most or all heating apparatus, is to raise the heat of the entire mass to the required temperature, without submitting some particles to a greater degree of heat than is necessary, or heating them in advance of the rest, to be stirred in and partially cooled again.

We believe that an even cook or scald is of the ut-

most importance, and that everything that can be should be done to secure that end. If thoroughly accomplished, with sweet milk to begin with, we have no fears as to the richness, fine flavor and good keeping qualities of the cheese. There is no other thing, in our opinion, which will go so far toward securing these three desirable qualities.

Another thing, as before indicated, we consider of great importance in securing a thorough cooking and proper separation of the whey from the curd. We refer to steadiness of temperature. It seems to us a great mistake, when the temperature is once up, to not keep it there, without rising or lowering. It seems a misapplication of terms to speak of cooking or scalding at a temperature of 98 or 100 degrees; yet, we all know that blood-heat is all that is required for cheese-making. This heat seems necessary. Perhaps it is because nature designed the gastric juice from the rennet to operate at the temperature. It is a well established fact that digestion will not go on when the temperature of the stomach is below that of blood-heat. We presume a much higher temperature is equally detrimental. This may account for the fact that blood-heat is the best for cheese-making, as at that temperature the rennet is most active. Be this as it may, we are satisfied that the process is retarded and the curd deteriorated by allowing the temperature to fall during the time it is in the scald. Instead of cooking, and condensing, as it should, in order to expel the whey, it is only soaking and souring. The moment the acid is sufficiently developed, though the curd be yet soft and raw, the whey is drawn, the curd is further cooled and soaked, and then dipped, drained, salted and put to press. A leaky cheese is the result. If the weather

is cool and bad for curing, a sour cheese follows. But whatever the weather may be, we doubt if a leaky cheese ever yet turned out all right in flavor and quality. It can never have that nutty, new-milk flavor which belongs to cheese properly cooked. We presume there are those who will differ with us in opinion, but we should demand the positive evidence of at least four senses before believing we are wrong.

We say, therefore, raise your temperature gradually and evenly, to full blood-heat, and there retain it until your curd is ready to dip. Then we believe it would be an advantage to dip and drain, without cooling more than what cannot be avoided, and salt warm. But of salting, we will speak more at length some other time. We are now discussing the question of heat. Let us give a little every-day illustration. Suppose the housewife were to put her potatoes for dinner in a kettle of water, run the heat up to 212°, and then allow it to cool by radiation until the potatoes are done. What kind of a dish would they make? Or, after she had cooked her potatoes, suppose she should let them stand and soak until they are cool enough to handle without danger of burning or scalding any one. Who would want to eat the watery things? The truth is, 212° is the proper temperature for boiling potatoes, and the sooner and hotter you can get them out of the water, the better. So, in our opinion, blood-heat, or 98° to 100°, is the proper temperature for cooking cheese curd, and that after the curd is done, the sooner and warmer it is dipped, the better for the curd—the sweeter, richer-flavored and better grained (not pasty, but more of the consistency of hard, well-made butter, which shows the butter globules whole) will be the cheese, and its keeping qualities will be correspondingly

improved. It may be a little more work to cool the curd in the air, and harder keeping it from packing; but if dipped warm, the whey will the sooner drain off, and the salt can be the sooner thrown on, when it will penetrate quicker, season the mass more evenly, and form a coating to the particles of curd, which will keep them from packing together.

But whether the curd is cooled before dipping or not, we maintain that it is a great advantage to keep the temperature up to blood-heat during the entire process after the heat is once raised. With self-heating apparatus, this can be done by keeping a very little fire going —just enough to supply the loss of heat from radiation. Where the heating is done by running warm water around the milk-vat, a current of the proper temperature can be kept up. If steam is used, perhaps a small jet can be kept pouring into the space around the vat. But in all these cases, the danger is that too high a temperature will have to be kept up at the point of applying the heat, in order to prevent the temperature of the whole mass from falling. This is a decided objection, and necessitates a great deal of stirring, which is only a palliative of and not a remedy for the evil.

Of course we write with reference to the management of heat with milk that is sweet and in proper condition for cheese-making. Where it is "old," or tainted, to begin with, it is necessary to hurry the heat, and every operation connected with the process of making it up. A higher temperature and less time will be found to produce a very similar effect to a lower temperature and more time. But, in all cases, an even, steady heat should be aimed at and maintained to the end.

We never could quite understand the philosophy of cooking less in the spring and fall than in the summer.

The idea that it makes the cheese more buttery to dip the curd raw, seems to us very absurd. If there is any time when a curd needs to be thoroughly cooked, it is when the weather is cool and unfavorable for curing. If the whey is not properly expelled by the action of heat, it has got to either dry out or leak out, or both. If there is too much left in the curd to dry out, long before it can leak out, your cheese will be sour, with a puckered face, and sundry ugly cracks. Even when the cheese does not absolutely drip, if the curd is dipped while underdone, it will sour, the face will have a corrugated appearance, and the cheese will "try" crumbly and sour. The color will also be paler than in those that are properly cooked, the general look will be clammy, and no rind will form that will be satisfactory. Even when well-cooked and well-made, if a cheese does not have sufficient warmth, it will sour on the ranges and spoil; and it stands to reason that cheese made from a curd insufficiently cooked must work a great deal worse under unfavorable conditions for curing. Our experience is, that a curd needs more cooking in the spring and fall than will answer in hot, dry weather. If we must have a curd dipped soft at any season of the year, we say let it be at that season when the weather is best for drying and curing. A cheese that would become worthless on the ranges in cold, wet weather, may turn out pretty fair in "dog days." But we do not believe in undercooking at any time. Food, of all kinds, needs as much cooking one season of the year as another. It is quite likely, however, that a degree or two lower heat will answer in cool weather, for the reason that milk keeps better then, and the curd remains longer in the scald before taking on acid. In this case, we have a lower heat for a longer time, which

will produce the same result as a higher heat for a shorter time. But in both cases the curd ought to be cooked the same. Whatever degree of heat is decided upon, let it be kept up, steady and uniform throughout the mass, and at all seasons of the year let the curd be cooked done. This is specially important when the conditions for curing are unfavorable. You must do, then, in the vat part of the work which can be done on the ranges when the weather is favorable.

CHAPTER XVI.

ACID.

Another important agent in cheese-making is acid. This you are pretty sure to have, at some stage of the process, and the chief question seems to be as to *when* you will have it. It is said that milk fresh from the cow manifests the presence of lactic acid. The quantity is very slight, however, and under favorable circumstances the development is slow. Where milk is properly cooled immediately after being taken from the cow, and the factoryman has good facilities for keeping it cool, it will be found, when the time comes to begin the process of working up, what is called "sweet." It will not taste as fresh and clean as when first cooled after milking; but no acid will be perceptible to either taste or smell—not even enough to make it what is termed "old."

Some think age makes the milk all the better for cheese-making, and we believe it is generally understood that milk fresh from the cow does not work quite satisfactorily. However, we place no great stress on this opinion. Old milk will work quicker than new milk; the acid will develop sooner to the point desired by the cheese-maker, and this saving of time doubtless has something to do with the decision in favor of age in milk for the purpose of cheese-making.

Our impression is, that milk cannot be too sweet when the rennet is added, and that if sufficient time is taken to develop the acid in the whey before dipping, the fresh milk will be found to turn out the finest-flavored and best-keeping cheese. The acid is not wanted in

the *curd*, but in the *whey*. If the milk is sour, to begin with, or quite advanced toward sourness, the latic acid must pervade every particle of the whole mass. Now, it strikes us that the correct idea is to expel the whey from the curd, as far as possible, before the acid makes its appearance, and let the acid develop in the whey afterward, so as to furnish a sort of pickle. The acid will develop sharply at some stage in the process; and, as we have before said, the question to be decided seems to be as to what point it is best to have it develop at.

We say, with the light we at present have before us, we think the acid should never be allowed to develop much before the curd is cooked and the whey is properly expelled; then let the whey take on acid to quite a perceptible degree before dipping the curd. We doubt if it makes much difference whether the acidulation takes place while the curd is floating in the whey, or after the whey is drawn off and while the curd stands and drains. There is rather more convenience in handling to leave the whey on and stir the curd sufficiently to keep it from packing; but the "cheddar" cheese, which is generally considered the best of any, is made by stacking the curd, after cooking, and allowing the whey that clings to it to take on acid. But where the milk is all right, to begin with, and the curd is properly managed and cooked, we doubt if it makes any material difference which process is adopted for allowing the acid to develop. With such a curd, there is little danger of its being injured by the acid, as any one can demonstrate by allowing curd to stand unpressed over night, as is often done with small remnants, when the pieces will be found covered with an almost vinegar-sour acid. Grind this curd and put it to press, and there will be no signs of sour cheese.

The development of the acid is absolutely necessary to secure good keeping qualities and a mild, clean flavor. Dip a curd before the whey has become perceptibly acid, or is on the verge of "changing," and we think that a rank, bitter flavor will be sure to follow. The absence of sufficient lactic acid leaves the albumen in a condition likely to decompose, while the butyric acid develops itself, as in rancid butter, and the two combine to make a very unpalatable flavor to one nice about the taste of his cheese. Some prefer strong cheese. To such, the nearer the flavor approaches that of smoked herring and tobacco, the greater the gustatory gratification.

The principal difficulty in working up sour milk is to get sufficient action of the rennet and heat on the curd to properly condense it and expel the whey. It is a mistake, therefore, to dip a curd soft because it is sour. Run your heat up to 104° or even 106°, as soon as possible, and keep it there until your curd is cooked. It is sour, and nothing but cooking will save it, if anything will. The whey must and will come out. If you do not expel it from the particles of curd in the vat, you will not be able to press it out sufficiently to keep it from working and leaking out while the cheese stands on the ranges.

If anything will prevent sour milk from making leaky cheese, it is thorough cooking. This process you should hurry up as much as possible—always having an eye to keeping the heat even, and preventing waste of butter. The acid, acting on the butter globules, makes their coatings tender. Therefore, handle the curd as carefully as possible, cool well before putting to press, and press gently, increasing the pressure gradually. But, if you have succeeded in getting your curd properly

cooked, you have done one of the best things possible to retain the butter. If, when you put the curd to press, you find you have more than the usual bulk of curd, filling the hoops fuller and refusing to yield readily to the pressure of the screw—as is generally the case with sour milk, as managed in most factories—you may know that you have not done your work thoroughly, and therefore look out for leaky, sour, poor cheese. On the other hand, if you have condensed the curd to the usual bulk, so that it works well under the screw, you may hope for a fair cheese, that may pass muster when the buyer comes along.

We often hear the remark, when anything is said about developing the acid, "No sour cheese for me; I prefer to dip my curd sweet." People who talk in this way either make bitter, bad-flavored cheese, or else get on more acid than they are aware of, in consequence of having dull taste and smell. They judge by the *appearance* and *feel* of the curd when it is in condition to dip, and may succeed in hitting the right point. In hot weather, it is hardly possible not to develop the acid sufficiently. But if they really dip the curd sweet, we do not believe it possible that their cheese can be up to the standard demanded by the best markets, though they may succeed in getting a fair price for it. Not all buyers are really good judges, and fewer still know what the matter is with a cheese that is imperfectly made. They know, perhaps, that there is something wrong about it; but what, they are unable to say. Further, we believe the average price of American cheese lower than it should be, in consequence of so little really prime cheese, and of the large amount of second-rate; and that, as yet, our buyers are not sufficiently discriminating in their purchases and prices,

though they are yearly growing more so. Both buyers and cheese-makers need more experience and a better understanding of what is requisite in the manufacture of a prime article.

CHAPTER XVII.

DIPPING CURDS.

There is nothing so difficult in cheese-making as to determine the exact point when a curd ought to be taken out of the vat and salted. A slight variation either way from this point makes an uneven lot of cheese, and much variation spoils the batch, so that it will not pass for "prime." Every cheese-maker has felt the want of some test whereby the exact point, when a curd is sufficiently "done" to dip, can be determined with certainty. Neither the sense of smell, the sense of taste, nor the sense of touch is infallible. The evidence of this fact can be seen in any factory during the season of cheese-making. A simple test of acidity, which is claimed to be conclusive, is the application of a hot iron to a lump of curd. The iron wants to be searing hot—not red hot, but hot enough to toast cheese. Take up a small handful of curd, squeeze the whey out of it, and touch the hot iron to it, holding it there for a moment, or until it adheres and begins to melt or toast the cheese. Then pull the iron gently away from the curd. If the curd is raw and sweet, it will break short off from the iron and appear crumbly. If slightly acid, it will slightly pull out in threads, but not very long ones. As the acid develops, the stringiness increases. At a certain point, the curd will cling to the iron and pull out in numerous fine threads an inch or two long. Beyond this point, the threads grow longer but fewer, until there will be only one, which will draw out a foot or so, and then break, recoiling somewhat like India-rubber. Indeed, the curd grows

tougher and more stringy from the time it begins to take on acid perceptibly, until it finally ends in stringing indefinitely, like wax, having passed the point of breaking and flying back. The successive stages of development are gradual, but very marked, and cannot fail to be recognized after a few experiments.

Thus having obtained a means of telling the degree of acid developed, it only remains to be decided at what point to dip the curd. It is claimed that the proper one is where the threads are the finest and most numerous. Beyond this point, the threads diminish in number but increase in length, which is an indication of too much acid. It is asserted that the hot iron test is uniform and reliable, besides being easy of application. Cheese-makers can make their own experiments, and we advise them to try the hot iron to their own satisfaction. If it should prove as conclusive as good judges think it will, it will be of immense value to our dairymen.

This test reminds us of the test used by maple-sugar makers to determine when the batch has reached the point where it will "grain" and "cake" well. They make a small bow of a twig, dip it into the sugar, which adheres to and fills it, and then they blow through the bow. If no bubble forms and floats off like a soap-bubble, the batch is not done. But if they can blow a string of bubbles, or one long bubble, it is time to remove the heat. The stringing of the cheese-curd, on the application of the hot iron, seems to afford a very similar test for the cheese-maker.

It is not claimed that the use of the hot iron will necessarily insure the making of good cheese. It only determines the degree of acidity, which is *one* very important point. Other things are requisite to the manu-

facture of a prime article, and the same care, attention, and labor, in other matters, will remain just as essential. By using the hot iron, however, it is claimed that the cheese-maker can tell, every time, just how sour his curd is.

CHAPTER XVIII.

SALTING CURDS.

We believe there is not much controversy on the question of salting curd. One says, salt it hot, and another says, cool it first. But the variation in temperature is but a few degrees, and can hardly be supposed to have much effect. On the whole, we prefer salting as warm as practicable, as the curd then takes the salt better and the seasoning is likely to be evener. But the sooner the salt is thrown on, the greater the waste will be from running off in the whey. If the curd were thoroughly drained, or pressed out, as it is by the English in the manufacture of cheddar cheese, before the salt is added, considerable less would be needed. Some salt the curd in the vat, while it is yet covered with whey, and think this the better way. We opine, however, it matters but little when the salt is added, if it be distributed evenly throughout the mass of curd and is used in the proper quantity. The common method is to salt in the curd-sink, while the curd is draining—generally as soon after it is dipped as it can be stirred into a loose condition suitable for evenly mixing the salt.

We have heard the opinion expressed that it matters not whether the curd is well separated after salting, or left in coarse chunks with the salt adhering to their surfaces when put to press, as salt is very penetrating and the pressing drives the salt whey all through the cheese. But the common practice is not based on such a conclusion, and we think it well that it is not. Even salting we consider as essential in cheese-making as in butter-making.

The amount of salt used at the different factories varies from four ounces to five ounces for a hundred pounds of milk, or from two pounds and a half to three pounds and an eighth for a thousand pounds of milk, or a hundred pounds of curd. The higher rate of salting is thought to somewhat retard the curing, but it will help the keeping qualities of the cheese.

For convenience sake, and to save time and the liability to mistakes when in a hurry, we would recommend the making of a scale or table, based on the rate of salting adopted, ranging from twenty or twenty-five pounds up to a hundred, and then for the hundreds up to the capacity of the vat. It takes but a little while, during some leisure hour, to make such a tabular scale. When made and stuck up in some convenient place—say, over the salt barrel, or over the balances—it will enable any one not familiar with or quick in figures to see at a glance how much salt is needed for the curd of a given amount of milk. It is a convenience, too, that will last as long as the factory, if taken care of.

For the benefit of whom it may concern, we give the following tables:

TABLE

For Salting at the Rate of 2 lbs. 8 ozs. to 1,000 lbs. of Milk.

MILK.	SALT.		MILK.	SALT.	
lbs.	lbs.	ozs.	lbs.	lbs.	ozs.
25	0	1	1,000	2	8
50	0	2	2,000	5	0
75	0	3	3,000	7	8
100	0	4	4,000	10	0
200	0	8	5,000	12	8
300	0	12	6,000	15	0
400	1	0	7,000	17	8
500	1	4	8,000	20	0
600	1	8	9,000	22	8
700	1	12			
800	2	0			
900	2	4			

TABLE

For Salting at the Rate of 3 lbs. 2 ozs. to 1,000 lbs. of Milk.

MILK.	SALT.		MILK.	SALT.	
lbs.	lbs.	ozs.	lbs.	lbs.	ozs.
20	0	1	1,000	3	2
40	0	2	2,000	6	4
60	0	3	3,000	9	6
80	0	4	4,000	12	8
100	0	5	5,000	15	10
200	0	10	6,000	18	12
300	0	15	7,000	21	14
400	1	4	8,000	25	0
500	1	9	9,000	28	2
600	1	14			
700	2	3			
800	2	8			
900	2	13			

We presume the method of using these tables will be plain enough to most cheese-makers. But we will give a single illustration. Supposing the batch of milk to be 4,640 pounds, if we wish to salt at the rate of 3 lbs. 2 ozs. to the 1,000 pounds of milk, we look at the column indicating the quantity of salt for a given number of thousands, and find that 4,000 pounds of milk require 12 lbs. 8 ozs. of salt. Referring to the other column, we find 400 pounds of milk require 1 lb. 4 ozs. salt, and 40 pounds, 2 ozs. Add these together, and we have 13 lbs. 14 ozs. as the quantity of salt required for 4,640 lbs. of milk. If desired, a table can be made out, with little trouble, that will show the quantity of salt required for any given number of hundreds of pounds of milk likely to be contained in a single vat.

CHAPTER XIX.

TAINTED MILK.

The most abominable of all things in a cheese-factory is tainted milk. It means floating curds, "huffy" cheese, bad flavor and poor prices. Yet, as milk is now managed, most factories will, in hot weather, get occasionally caught with a mess of tainted milk. There are hard work, anxiety and unsatisfactory results in it for the cheese-maker, and dissatisfaction and small profits for the patron. Such things never ought to be; but, when such a catastrophe happens, like other disagreeable things, it has to be borne and the best made of it that circumstances will permit.

We know of no way to make good cheese out of tainted milk, and have had comparatively little experience with it—though quite as much as we desire. But from our own knowledge and what we can learn from the experience of others, if we had a tainted mess of milk to work up, we should heat it up as soon as possible, cut the curd fine, cook it thoroughly and develop the acid as much as we thought the curd would bear and stick together so as to bandage well. If we had another batch, in which the whey was all right, we would draw off the whey from the tainted batch as early as possible and add whey from the sweet batch to the tainted curd, to cook it in. If not, as soon as cooked, we would draw off the whey and allow the acid to develop in the curd. We presume sour whey added to the batch would be an advantage in developing the acid, and acid is what seems to be needed to check the decomposition and further tainting of the curd.

An extra quantity of salt would doubtless be an advantage in stopping further taint. The curd should be cooled to the temperature of the atmosphere, and well aired before being put to press, and the pressing should be thorough.

Old cheese-makers have told us that they thought they found an advantage in washing and cooling a tainted curd with ice water—that is, by chilling it. It seems to us that, though this might check taint for the time being, it would hasten it when the cheese warmed up in curing, as butter or meat will spoil rapidly after having come in contact with ice, if exposed to the atmosphere.

Prime cheese never can be made of bad milk. But, if milk is not too badly tainted, a mess managed on the principles we have indicated will make a fair cheese—one that will suit many palates. A curd made of sour milk may be improved by washing out some of the acid by the use of warm water. With such a curd, extra cooking is an important point; but generally there is less cooking, owing to the hurry to get the curd out of the sour whey. It is in almost the opposite condition, so far as acid is concerned, of curd made from tainted milk. The latter has too little acid; the former too much. We therefore want to develop the acid in a tainted curd, and to retard or diminish it in a sour one.

CHAPTER XX.

CURING.

There is no part of the process of making up milk and getting the product ready for market which requires more care and judgment, as well as some hard work, than curing. Few rooms are properly prepared for the purpose. They are left too open and barn-like, with no means of controlling the temperature. Factorymen generally seem to think that if the cheese is only made and put on the ranges, there is little or no need of making any further provision. We have seen cheese, which we believe had deteriorated from one to two cents a pound in value, because the curing process had not gone on properly. The curing rooms were full of cracks which let in the wind, cold or hot, dry or damp, as it might be, and the cheese stood on the ranges in the cold, damp atmosphere, turning to swill—to hog feed, instead of human food. The faces were cracked; the flavor was bad; "too much acid," the buyers said; the makers were perplexed, and quite sure they had not changed their hands from what they were when they made a good reputation; the patrons were dissatisfied, and the committeemen grumbled. There might have been other failings; but we are quite sure that no one has a right to expect prime cheese where there are not the proper facilities for curing. If the weather happens to be right, a barn may answer the purpose. But no one has a right to presume on always having favorable weather; and it is the part of wisdom to make preparations for all sorts of contingencies.

A curing-room should be made with a wind-proof wall. This would guard against sudden changes of

weather, by keeping out both heat and cold. Sufficient air can be introduced through the windows, which should be made to open easily, and be provided with blinds. There should also be provision for supplying artificial heat, equally distributed throughout the building, and not from a red-hot stove set in the middle, or in one end or corner, where it will toast the cheeses near it, and leave those farther off to chill in the cold weather of spring and fall. If steam is used, the heating apparatus may be made to do the double work of cooking the curd, and warming the drying-room. This may be done by means of hot-air tubes, or by the use of steam-pipes running round the room. Of course it would cost a little at the beginning; but a curing room once properly fitted up would soon pay the extra expense in the saving of time, labor, care, vexation and money. A thousand and one annoyances would be guarded against, and the proprietor would have the satisfaction of knowing that he had got a good thing, which would insure the most that could be expected from the product of the cheese-vat, and build up a first-class reputation and a permanent business.

A curing-room should not only be kept at an equable temperature of 70° to 80°, but be well ventilated. The gases constantly emitted by the curing process should have a chance to freely escape and leave the atmosphere as pure and sweet as possible. There is no more sense in supposing that a cheese can cure properly and have a clean, wholesome flavor, if kept in a close, unventilated room, than that a human being can retain his health in impure air. The curing-room must be kept clean and sweet, dry and airy—not by allowing the wind to whistle through it as it listeth, but by a judicious system of heating and ventilating, which will allow the hot and chill blasts to blow harmlessly by.

CHAPTER XXI.

GREASING CHEESE.

When a cheese is first removed from the hoops, care should be taken that its face be not allowed to dry and crack before it is greased with hot whey-butter. Nothing has been found so good as whey-butter for the purpose of greasing cheese, and it should be applied hot, and as soon after the cheese is set on the range as possible. If it dries at all, we think it injurious to the formation of a smooth, glassy face; and if it dries much, the face is sure to check and present an unsatisfactory appearance, besides furnishing convenient places for the cheese-fly to deposit its eggs.

A very convenient thing for applying the hot butter is a paint-brush. It is much handier and better every way than a swab. But care must be taken, or the bristles of the brush will get scorched. This can be avoided by removing the brush from the dish when through using it, and not putting it in the grease again until you are ready to grease the faces of your cheeses.

A pressed iron dish with a handle riveted on, is handy for melting the grease. There is no danger of melting out the bottom, or melting off the handle, and you are less liable to burn yourself or spill your grease than you are if you melt the whey butter in an old basin, which very soon gets burnt and leaky.

Little conveniences, like the iron dish and brush we have mentioned, help a great deal, in the course of a season, about cheese-making; and a cheese-maker had better furnish them at his own expense, if his employers are too stingy to do it, than not to have them. There

are many such little things that greatly assist in doing work easily and in keeping neat and tidy. One can do without them, on the principle that a farmer can hoe his corn without a cultivator, but it does not pay.

If a cheese cannot be greased as soon as taken out, spread a cloth or put a turner over it, or both. This will keep the moisture from escaping and the air from immediate contact with the face of the cheese.

As whey-butter is the best and nearly the only material used for greasing the faces of cheeses, it will not be amiss and may be of use to inexperienced cheese-makers, to say a few words on the mode of trying out the whey-butter. Prepare a skimmer with a long handle, which may be cheaply made by punching the bottom of an old tin-pan full of holes and fastening a wooden handle to it with bits of wire. A shrub five or six feet long and of suitable size, with a short crook at the larger end, is convenient. It can be split at the crooked end, slipped on the edge of the pan and wired there without much trouble.

Hang a large kettle—a cauldron is best—in a convenient place, and fill it about two-thirds full of the grease and scum which you skim off from the vat. It is yeasty stuff, and requires a good deal of room, at first, to swell in when the heat is started. Keep up a moderate fire, so as to boil it gently without scorching, and continue the boiling until the cheesy portion is sufficiently cooked to sink to the bottom. Then allow the batch to rest and cool down. Dip off the butter, while still warm and oily, and carefully strain it into a clean tub. When cooled sufficiently to begin to thicken somewhat, a little salt sprinkled on the surface and thoroughly stirred in, as the farmers' wives sometimes salt their lard, will help prevent it from getting rancid

and stinking. Set it in a cool place, and keep it covered tightly. Near the close of the fall's operations, a nice tub of whey butter should be thus prepared and set by for use the next spring—for, in the cold spring weather, when cheese-making first commences, very little cream will rise on the whey-vat, and it will take some time before a batch can be procured.

In applying the whey-butter to the face of the cheese, no more should be used than the surface of the cheese will absorb and leave it moist and shiny. If enough is put on so that it will cool in streaks and stick to whatever it touches, it should be wiped off, or it will daub the turner or bench, and not only make unnecessary work in cleaning, but prevent a hard, smooth rind from forming. Many give themselves a good deal of annoyance by putting on too much grease.

The next morning after the cheese has been set on the range, and had its upper face greased with hot whey-butter, it should be turned over, when a similar application of hot butter should be made to the other face. If the cheese is well made and of good milk, and properly greased, as we have indicated, more greasing will seldom be needed. A little care will determine when more is needed, if at all. If the face begins to look dry and feel harsh, in spite of thorough rubbing with the hands, call the grease-brush into requisition again. In hot, dry weather—especially if the air is allowed to strike the face of the cheese—a timely application of more whey-butter may keep the face from cracking and save considerable trouble.

The cheeses should be regularly turned, for the first fortnight, every day, and have their faces thoroughly rubbed and polished with the naked hand. Nothing else will do so much to help form a satisfactory rind.

A cloth carried along should be used to wipe off any surplus grease on the bench or turner, so as to prevent its daubing the next cheese and making additional work. This same cloth, thus made greasy, will answer the additional use of wiping off any moud that may be found collecting on the bandage.

In this way, a lot of cheese, with comparatively little additional work and trouble, but a trifle more attention, can be kept looking clean and wholesome; and if this neatness does not actually help improve the quality of the cheese—we think it does—it will so much improve the appearance, that you will not only be rewarded by the satisfaction afforded, but can safely count on a fraction more from the buyer—enough to more than pay for all the labor bestowed in curing.

CHAPTER XXII.

SKIPPERS.

One of the most annoying things in the drying-room is the cheese-fly. It is very small but very effective in its way; and as it has the power to so rapidly increase its numbers, it sometimes gives a good deal of trouble. To a beginner, its ways seem almost past finding out, yet its path often becomes disgustingly visible.

We know of no sovereign remedy for these pests of the drying-room. The best preventive is perfect cleanliness in all the surroundings. No pools of whey or slops of any kind in, under or around the building, should be allowed to furnish the first broods. But few factories are so arranged as to leave no putrid whey-spouts or other receptacles for the eggs of the fly. When hot weather comes on, the flies, therefore, swarm all around the building; and most curing-rooms are so open as to afford them easy access. Once in the room, the trouble and warfare begin, and cease not until the dog-star no longer rages.

The cheese-fly is not very particular where it deposits its eggs—whether in the cracks in the benches or turners, in wrinkles in the bandage, in the checks in the rind of the cheese, or on the smooth face. If the weather is warm enough and there is the least bit of moisture, the eggs will hatch anywhere around the cheese. As soon as hatched, instinct leads the skipper to burrow in the cheese at once. It is a mistaken idea, we think, that the fly inserts the eggs. It drops them in clusters, wherever it is convenient. It may be on a turner, which is standing idle. It is taken up thought-

lessly, clapped over a cheese, which is turned on it, nicely covering the eggs, which hatch between it and the rind, and the brood is soon found thriving nicely in the cheese. Perhaps the eggs are laid on the smooth face of the cheese, in plain sight, if one looks carefully enough for them. The next time the cheese is turned, the eggs are in the same situation as those laid on the turner. They may be laid on the bench, and the cheese set on them. A careful hand, who is used to hunting eggs as well as skippers, will look closely for them everywhere, and be sure that the face of no cheese that has them on is turned down, and that no turner is used containing them. In all these cases, care and neatness have their advantages, and pay.

If a cheese is leaky, look out for it. We have seen the eggs of the cheese-fly deposited on the best cheeses; but sour, stinking, leaky cheeses attract them most. Here they are in their natural element. The eggs dropped on the moist cheese anywhere, even on the bandage, will do remarkably well. They no sooner hatch, than the tiny worm works its way through the bandage or rind into the cheese, and there he feasts, fattens and grows.

It is almost traditional that a skippery cheese is invariably a good one. We admit that good cheese may be skippery—it is so, sometimes; but the leaky, greasy, rank smelling and strong-tasting cheese, is the skipper's delight. In such a cheese, he luxuriates in all his disgusting glory.

When skippers get into a cheese, we know of no better way than to dig or cut them out as soon as possible. Their presence is at once indicated by a moist spot, when the bottom face of the cheese is first turned up. Greasing a piece of paper over the hole in the

cheese, which is the entrance of the skipper, will bring him to the surface after air, but it does not kill him nor free the cheese from skippers. We say, cut them out. Cut freely, and make sure work. If the spot is near the edge, a wedge-shaped piece may be cut out, and a piece of another cheese—there is usually one cut for patrons of a factory—can be fitted in, a second bandage drawn over, and the cheese slipped into a hoop, when a little pressing will smooth down all roughness and heal all scars.

Some put cayenne pepper in whey-butter used for greasing cheeses. But, though it may help keep flies off, it will not prevent trouble. They will work their way wherever there is a chance for them. Dryness, cleanliness and watchful care, are the only sure preventives of skippers, in hot weather. To one who has had experience, it is not so very difficult to guard against serious loss from skippery cheese. But beginners need to be put on their guard—and for their benefit we have penned this article on skippers.

CHAPTER XXIII.

CHEDDAR PROCESS.

During the summer of 1869, we had the pleasure of visiting the Spring Creek and Slate Hill factories, in Montgomery county, under the charge of Mr. ALEXANDER MACADAM. Mr. MACADAM'S father is an old cheese-maker, who learned the Cheddar process from the celebrated English dairyman, Mr. JOSEPH HARDING, of Somerset, about 1855. The son has had all the advantages of the father's experience, and, in addition to an active, inquiring and practical turn of mind, has had experience in one of the heaviest cheese houses in London. If any one knows what good cheese is, and what is required by the English taste, as well as by the American market, we think Mr. ALEXANDER MACADAM does. He is, besides, intelligent, free and communicative—ready to impart any information within his knowledge. We propose to give as intelligible an account of his process as we were able to pick up in our brief visit. But, as he adopts in part the American method, and humors considerably American ideas, we will first give a brief description of the real Cheddar process, as explained in a pamphlet written by Mr. ROBERT MACADAM, of Gorsty Hill Dairy, Crewe, who is the father of our host:

In describing the process of cheese-making, it is necessary to keep in view some definite size of dairy; and for this reason, we will allude in the present section to one making cheese from the milk of 60 cows.

As detailed in the paragraph on the morning's operations, the evening's milk having cooled down to 62°, is lifted and sieved into the cheese tub, and the morn-

ing's milk added to it, as it comes from the cow-house. If the temperature of the milk, when thus mixed, be under 78°, it must be raised to that degree of warmth, as from 78° to 80° is the best temperature at which milk can be set for coagulation. This may be effected either by warming a portion of the milk among hot water to any temperature not above 150°, or, when the cheese-tub is double-bottomed, by introducing a jet of steam, or allowing the hot water to circulate. The quantity of milk in the cheese-tub being one hundred and sixty-five gallons, the requisite quantity of annotto is now added, and carefully mixed, to produce a rich straw or cowslip color. Five quarts of sour whey being added, and a quantity of rennet sufficient to coagulate the mass of milk in sixty minutes, the whole is gently stirred and completely mixed, covered over with a clean cloth, and allowed to stand for coagulation. After the milk has stood for fifteen minutes, the top or surface should be gently stirred, to prevent the cream from ascending, and this must be repeated if the curd is long in beginning to form. Hence it is preferable that the coagulation should be completed in from fifty to sixty minutes, as otherwise a waste of richness is likely to ensue. When the cream shows a decided tendency to rise to the surface, it is advisable to skim it off, previous to lifting the evening's milk, and warm it to a temperature of 95°, as this prevents it from ascending, and causes it to amalgamate more completely with the mass of milk set for coagulation. In stirring the milk to prevent the cream from ascending, the strictest attention should be observed to abstain from doing so if the slightest degree of coagulation is perceived. As soon as the curd has acquired a moderate degree of firmness, the operation of breaking-up should be at once commenced, and must be performed carefully, gently and minutely. This may be accomplished by one person in about thirty minutes, when the revolving knife breaker is employed, or by two persons in about the same time, when the shovel or wire-breakers are used. Before this operation is finished, a quantity of whey must be taken from the cheese-tub, heated to 150°, and

again poured upon the mass, stirring being actively kept up beneath the stream, to prevent any portion of the curd from being scalded. The quantity thus heated must be sufficient to raise the temperature of the contents of the cheese-tub to 80°, and the whole must be carefully and completely mixed. The addition of warm whey raises the temperature, and consequently hastens the separation of the whey from the curd, and assists in promoting the necessary acidity. [If, however, the presence of acidity can be detected by the smell or taste, no warm whey should be used at this stage of the process.] The curd being broken to a sufficient degree of fineness, it is allowed to remain undisturbed for one hour, except when the acid exists in too great a degree, in which case it should only stand during the time occupied by warming the whey for scalding. The whey-separator is then inserted, and the liquid allowed to run off until the surface of the curd appears among the whey, after which the separator is taken out, and the curd properly broken up with the shovel-breaker. But before breaking up the curd, a quantity of whey should be heated to 150°, for the purpose of scalding it. One person pours a portion of this hot whey over the curd, while another stirs actively beneath the stream with a shovel-breaker. The hot whey is poured cautiously over the mass at intervals, and the stirring is kept up gently but briskly, until the temperature is raised gradually to 98° or 100° Fah. The stirring is continued, and the temperature maintained, until the curd acquires a certain degree of firmness and consistency, which it is difficult to describe, but which the intelligent cheese-maker soon learns to recognize by its appearance, and by its peculiarly elastic feel when handled. It is therefore of the utmost importance to possess the discrimination and tact necessary for discerning when the proper degree of firmness and consistency has been attained. When the curd is sufficiently "cooked," it is in small granular particles, firm and elastic to the touch, and when a portion is taken in the hand and squeezed, it does not readily adhere, but separates into particles. The stirring must be continued till this peculiar con-

sistency is attained, without any regard to the length of time, but should on no account be further prolonged, because the cheese will then have a tendency to be hard and stiff, and will require a longer time to mature in the cheese-room. The length of time required for stirring varies according to the previous condition of the milk, being from twenty to thirty minutes when the acid exists in a sufficient degree, or even double that time when the natural process of change in the milk has been slow. This process of saturating the curd with heated whey has the effect of completely separating the solid and fluid parts, the only moisture left being that which adheres to the particles, and which comes away under pressure. But when the temperature is raised in this manner, or by heat from the bottom of the cheese-tub, the utmost care is necessary to keep the curd from being over-scalded, as, when the temperature is too suddenly raised, part of buttraceous matter may be lost, and the small pulpy particles get skinned over, inclosing a quantity of the whey, which it is extremely difficult again to separate. If the milk has been in proper condition to begin with, and the process carried on in the manner thus detailed, the curd will retain all the natural richness of the milk, and the cheese produced will have that rich creamy taste and sweet milky flavor, something like the odor of new milk, known as the *Cheddar flavor*. When the curd is raised (in the manner described above) to the natural heat of the milk (98°,) or only one or two degrees above it, all the butter is retained and fixed in the curd; for although subjected even at first to a pressure of half a ton, little or no trace of butter will appear. This is unquestionably a more rational and far superior method of separating the whey from the curd than that of heating beside a fire or in a furnace, with its attendant skewerings and changings.

The next step in the continuation of the process is to insert the separator, after the curd has been allowed to remain undisturbed in the scald for the space of thirty minutes. After the whey is run off, the curd is thrown

up into a heap in the center of the cheese-tub, covered over with a clean cheese-cloth, and the whey allowed to drain away from it for another half-hour. At the end of that time the curd is cut across, turned over in square lumps, heaped up, covered as before, and then allowed to lie for half an hour longer. The curd is then taken from the cheese-tub, laid upon a cooler, split by the hand into thin flakes, and spread out to cool. The curd at this stage has a distinctly acid smell; it is slightly sour, and by no means palatable; and its taste and appearance are such as would lead a novice to think it unlikely to produce a fine cheese. When the curd has been exposed on the cooler for fifteen minutes, it is turned over, and allowed to lie for the same length of time. It is then packed into a cheese-vat, having a clean cloth under it, placed under the press for the space of ten minutes, and subjected to a pressure of half a ton. When taken out, it is ground in the mill, weighed, and returned to the cooler, and if the acid is sufficiently developed, it should be at once salted, cooled down to about 65°, and placed under pressure. The purest refined salt should be used, and should be weighed and carefully mixed with the mass, one pound of salt being sufficient for fifty-six pounds of curd.

When the acid is found to be insufficiently developed in the previous stages of the process, the curd is allowed to lie unsalted, and is stirred up occasionally, until the necessary degree of acidity is acquired. The curd is then finally put into the cheese-vat, and at once put under pressure, at first under a weight of five or six cwt. The cheese is taken out of the press in the evening, and a clean cloth put upon it, and being turned in the vat, is subjected to a pressure of half a ton. Next morning, it is again taken out, wrapped in a dry cloth, reversed in the vat, and returned into the press with four cwt. additional pressure placed upon it. On the following morning it receives its third and last cloth, and when placed in the press, is now subjected to the pressure of 18 cwt. In the evening, it is once more removed from the press, gets a calico cap neatly stitched

upon it, is reversed in the vat, placed under a pressure of one ton till the following morning, and is then finally taken from the press. The cheese is then tightly bandaged to preserve its proper shape, and being ticketed with its date and number, is carried to the cheese-room, where it must be turned every day until fully ripe for market. Cheeses may always be in the store-room in seventy-two hours after they are first put into the press, and, indeed, they might be placed there much earlier; only to insure consolidation, it is preferable to maintain the pressure during the time specified.

A diary or register should be kept, into which the date and number of each cheese should be formally entered, together with such remarks as may be needful and proper concerning the condition of the milk, and the peculiarities of the curd, &c. The cheese-maker, when testing the quality of any cheese after it is ripe, may learn from the register the precise conditions of its manufacture, and will thus be assisted in attaining that degree of excellence which was laid down in the beginning of this work as a proper standard or quality.* It will also be found highly useful to note down many similar facts, such as the various yields of milk at particular seasons, and from different kinds of pasture or house-feeding, as the practice will not only give wide views of the subject, and correct information regarding it, but will also tend greatly to foster accurate and business-like habits.

It is necessary to state distinctly the mode of procedure best adapted for this contingency, because the over-acidity of milk when not detected and duly attended to in the process, produces a corresponding blemish in the cheese.

In very warm weather, when the temperature of the evening's milk stands in the morning as high as 70° or upwards, every part of the process described in the previous section must be hastened. The curd is broken

* "A good cheese is rich, without being greasy, with a sweet, nutty flavor; clear, equal color throughout; of a compact, solid texture, without being waxy; firm, yet melting easily in the mouth, and leaving no rough flavor on the palate."

more speedily than usual, and whey is taken off as soon as possible, and quickly warmed for scalding. When the operation of breaking is concluded, an interval of only five minutes is allowed before the whey is run off. Scalding is then proceeded with, but, under these circumstances, the curd and whey should only be raised to the temperature of 98°. When the proper degree of firmness has been attained by stirring, the rest of the whey is run off after another interval of five minutes, and when the curd is heaped up, ten minutes only are allowed to elapse before it is cut across and turned over. At the end of other ten minutes, it is laid upon the cooler, in five minutes more it is turned over, and at the end of other five it is put into the vat and under the press. Having been subjected to pressure for five minutes, the curd is taken out, ground in the mill, put back into the cooler, and salted. It is then stirred up to cool, until the temperature of the mass is reduced to 65°, when it is placed in the vat, and subjected to the ordinary routine of pressure. It may be stated, in illustration of the time occupied by these operations, that if the curd be ready for breaking at eight o'clock, it may be milled and salted by eleven. By expeditiously conducting every stage of the process, excellent cheeses may be produced, even at the above temperature; but when the ordinary time is allowed to elapse before the curd is "cooked" and salted, the cheeses will likely be sour. These rules and statements are based on the safe ground of personal experience, for in a very warm season we have made upwards of forty tons of cheese without one being sour.

In these days of dispatch and outward display, when men seek so eagerly for the shortest and easiest ways of doing things, some will doubtless be found to carp at the minuteness and extent of the foregoing details, and at the repeated injunction to strive after a clear and intelligent conception of the principles on which this branch of industry is founded. And many more, whose past experience has been little else than a slothful compliance with false rules and prejudices, may, perhaps, censure the system as too abstruse and compli-

cated. But all such objections are refuted by the simple fact that no common product, made from raw material universally the same, varies more in quality and value than cheese, from the one cause of difference in the skill with which it is made. To attain to excellence in cheese-making, it is absolutely necessary that the hand and the head should work together.

The Cheddar process, as carried on at Spring Creek factory, is an adaptation of the foregoing to America apparatus and implements, with other variations. The milk is set in the usual manner, and at the usual temperature—say, 82° to 84°. It is cut in the usual manner, and gradually heated up to 98°. Then the whole is allowed to stand, with occasional stirring, until the whey is perceptibly acid. The day we were there, we found the curd in the whey, and as much changed as is generally considered by Americans sufficient for dipping and salting. But as soon as a slight change is perceptible—indeed, as soon as any one of the hands fancies it is changed—the whey is drawn off. If the whey should still be sweet and the curd soft, there is no harm in drawing off the whey. Then one end of the vat is raised, the curd is poked away from the lower end, and the whey is allowed to drain out. If the curd is quite soft, the further separation of the whey is facilitated by cross-cuttings with a large butcher or groceryman's cheese-knife. If it is well "cooked," this is not necessary.

At the expiration of half an hour or so—provided the whey is not rapidly taking on acid, in which case, at the expiration of five, ten, or fifteen minutes, according to condition—the curd is cut into pieces six or eight inches square, with the knife just mentioned; these pieces are split laterally through the middle with the

knife; the top and bottom surfaces are put together, and the whole piled up along the sides of the vat. The object of this operation is to get the cool surfaces into the middle, to be influenced by the heat, and to give the already heated center contact with the atmosphere. In a little while, the bottom pieces are piled on top. The cutting and splitting operation may be repeated at intervals of twenty or thirty minutes until the whey that runs from the curd has much the taste of sour milk just before it begins to lopper.

The whey looks white and rich, and is really so; but it is claimed, that there is not as much waste as is caused by keeping the curd in the whey and stirring it, when the butter and cheese that escape are so diluted as not to be noticed.

When the whey draining from the curd has a decided sour-milk taste, the accumulation is removed, the curd mill is set on the end of the vat, and the large square pieces of curd thrown into the hopper and run through. The mill tears them into pieces varying in size from that of a kernel of corn to a butternut. When ground, two pounds and an eighth of salt are sprinkled over the curd and stirred in. (Considering the dry state of curd, this is really heavy salting—heavier than three pounds thrown on the dripping curd, in the usual manner.) The salting done, the curd is allowed to stand, with occasional stirring, as long as convenient—indeed, the longer the better. It will take no harm after being salted; and if a curd is at all tainted, or is made of sour-milk, and is rather soft, it should be allowed to stand as long as possible, and permit the hands to get it to press and ready to bandage the same afternoon or evening.

This is the simple process, as we saw it at Spring

Creek factory. The pressing and curing are not essentially different from the common methods. Thorough pressing, however, is considered essential; and so is an equable temperature in the drying room—which, by the way, Mr. MACADAM did not have the advantage of, as the building was erected on economical principles, with a very primitive but thorough system of ventilation—not under his direction or supervision, however.

With sour-milk, Mr. MACADAM hastens every stage of the process, up to the time of salting. When the requisite degree of acid is developed, even though the heat may not have gone above 90°, and the curd is very soft, the whey is drawn off, and the curd repeatedly cut into small squares with a knife, to facilitate the separation of the whey. The curd is ground, and the salt thrown on—in less quantity—when the whey that drains off has the proper sour milk taste. It is then allowed to stand in the vat, and drain and harden, as long as the work of the factory will permit. If it can remain a couple of days in the press, it is an advantage.

The curds prepared in the manner we have been describing for good milk, does not have a very promising look to an American cheese-maker. It is tough and stringy, and quite elastic. At least, such was the appearance of the curd which we saw. It is proper to state, however, that it was made of tainted milk, and the taint was quite marked in the curd. This, Mr. MACADAM told us, was the condition of most of the milk and curds for some weeks past in that factory; yet, the taint did not show in the cheese on the ranges, except in a few instances where the curd had been salted a little too sweet, as he thought.

The great secret of his success, he seemed to think,

was in getting rid of the whey early, in allowing a good deal of acid to develop, especially in tainted curds, in airing the curds and allowing the gases to escape, and in salting well.

Mr. MACADAM'S cheese, as a general thing, tried splendidly. It was firm, flaky, buttery and fine-flavored. His opinion is, that American cheese is, as a general rule, salted too sweet and too low, for the purpose of having it cure quick for market; but it lacks good keeping qualities, and verifies the old adage, "Soon ripe, soon rotten." It is hard to overcome this desire for quick returns; but he would recommend those who wish to improve American cheese, to sour rather more, salt a little more, and color a little less—as little as the market will allow—as coloring is believed to be positively injurious to quality. The *tendency* should be in these directions, in order to make a slower curing, better keeping and better flavored article.

But, it must be borne in mind, that Mr. MACADAM has in view his own process of manufacture, and that allowances must be made for different modes. Let each be ready to receive hints, make his own experiments, and abide by his own decisions.

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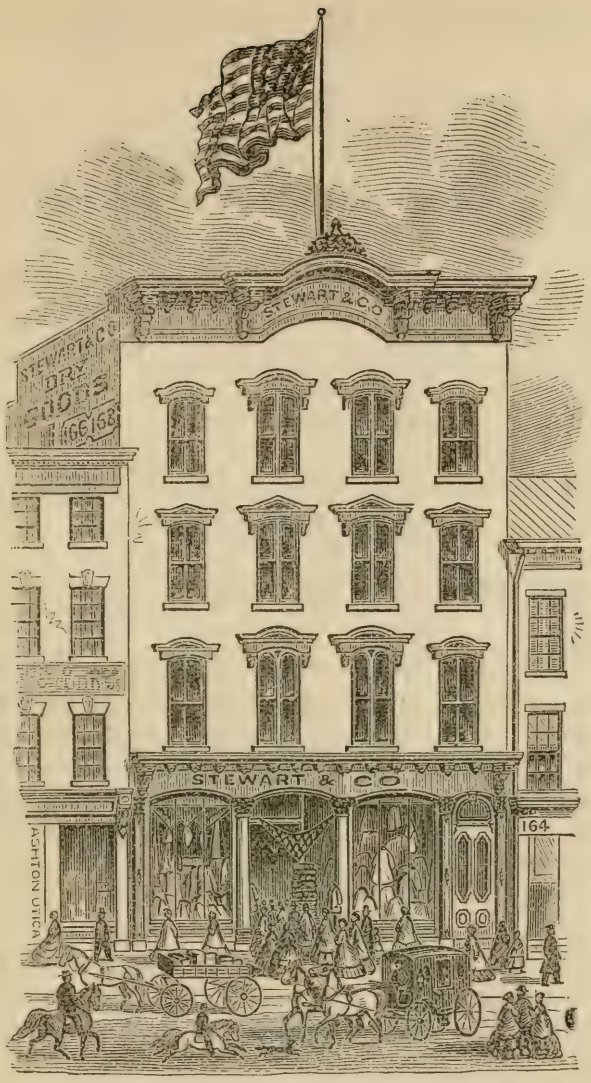

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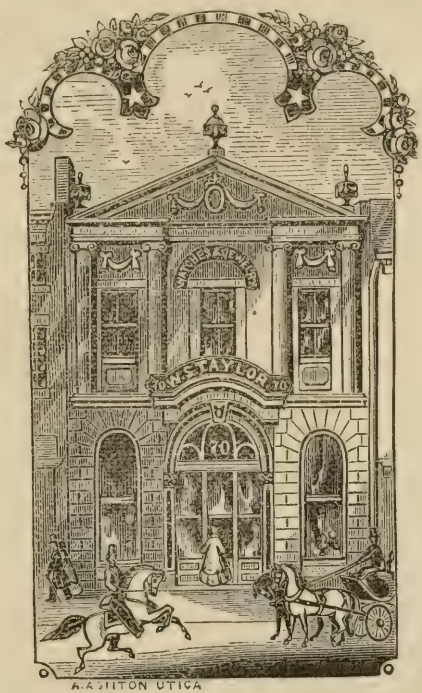

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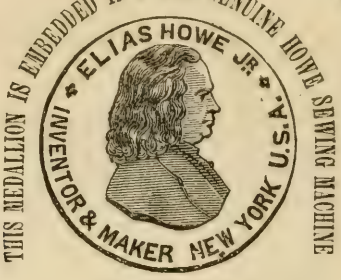

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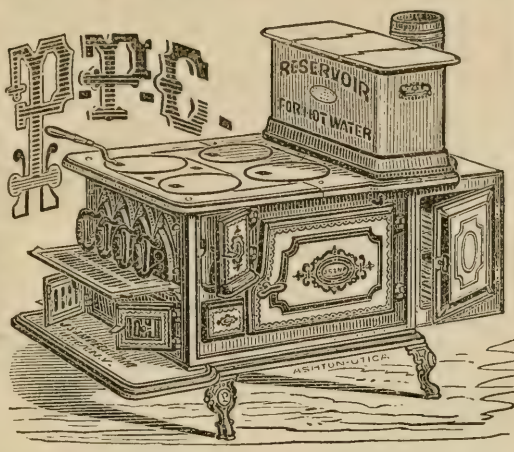

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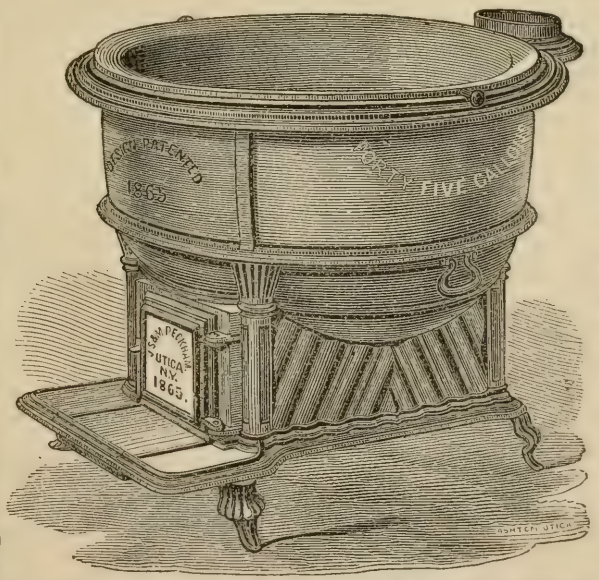

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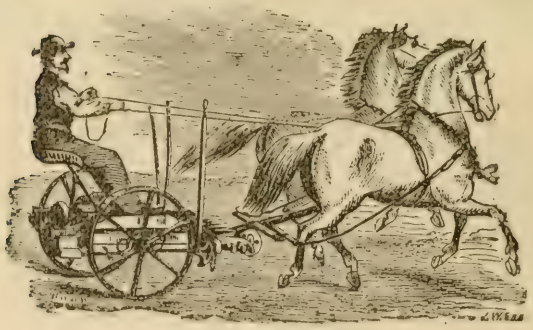

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